THE

AMERICAN NATURALIST

VOL. XXIV. OCTOBER, 1890. 286.

THE MESODERM AND THE CŒLOM OF VERTEBRATES.

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THE morphology of the mesoderm is one of the most vexed questions of the day. Scarcely an embryologist can be found who has not published opinions on this question considerably at variance with those of most others. It has been maintained that the mesoderm arises from the ectoderm; that it arises from the the entoderm, or from both; from neither, but from two special segmentation spheres; that it has a double origin, part coming from the blastoderm, part from the yolk; and even that there is no mesoderm.

We now know positively that in all vertebrates there is a distinct and unmistakable mesoderm, which spreads out from the primitive streak in all directions, and has distinctive histological characteristics. Two large cavities appear in this mesoderm on either side of the median axial line. The mesodermic cells which bound these two cavities assume an epithelial arrangement, and are designated as the *mesothelium;* the cavities constitute the *cœlom;* the remainder of the mesoderm is known as the *mesenchyma*, and corresponds to the embryonic connective tissue of older writers. The mesothelium at various points throws off cells, which are added to the mesenchyma. We have accordingly two distinct phases to study, viz., the origin of the mesoderm, and the differentiation of the mesenchyma and mesothelium, and together with the latter the formation of the cœlomatic cavities.

I. ORIGIN OF THE MESODERM.

Mesoderm of Elasmobranchs.—In the cartilaginous fishes the mesoderm arises from the entoderm close to the ectental line. The observations of Balfour in his monograph, *2* (see also his works, I., 246–268), established the fact that the mesoderm appears after the two primary layers and is connected with the entoderm. This fact has since been abundantly confirmed (see Kollmann, *25;* Swaen, *41;* Rückert, *32, 33;* Rabl, *29;* D. Schwarz, *36*, et al). These later observations, particularly those of Rückert and Rabl, have settled the exact point, or rather area, of entoderm which is mesoblastogenic. Unfortunately Rabl overlooked the phenomena of concrescence, and consequently reached conclusions as to the development of the mesoderm which I feel no hesitation in pronouncing erroneous. The mesoderm is differentiated along the embryonic rim before concrescence takes place; hence, when concrescence is partly completed, there is an axial stretch of mesoderm, and from the hind end of this the mesoderm spreads out toward each side along the embryonic rim in connection with the entoderm, as has been described.[1] We can distinguish the axial mesoderm from the lateral mesoderm; but later on, when concrescence has progressed further, there is no lateral mesoderm, for it has become axial. Rabl, however, failed to study the later stages, and so came to consider that this temporary condition of the mesoderm signified a double origin; accordingly he distinguishes between the "gastral" (axial) and "peristomal" (lateral) mesoderm, and makes the unsuccessful attempt to show that the "gastral" and "peristomal" mesoderms are of essentially different origin in all vertebrates. Had Rabl accepted the law of concrescence, he would certainly have not fallen into these errors. There is no evidence whatever that there is an evagination of the entoderm, as the Hertwigs maintain can be shown in the amphibians (see below). On the contrary, the cells grow forth from the entoderm, so as to constitute a sheet between the primary germ-layers. Soon the connection with the entoderm is permanently severed.

[1] AMERICAN NATURALIST, 1890, p. 507.

The fact that the mesoderm appears first in the embryonic rim renders it easy to make sure of its springing from the entoderm. Later, when concrescence moves the rim into the axial line, all three germ-layers are united in the axis of the primitive streak, and it becomes more difficult to decide which of the layers the mesoderm is specially connected with. To conclude: In Elasmobranchs the mesoderm arises over a limited area of the entoderm near the ectental line; it separates from the entoderm apparently by a process of delamination, but the exact means of separation have yet to be investigated; it remains for a while connected with the entoderm along the embryonic axis; after its separation from the entoderm the mesoderm expands by proliferation of its own cells, and receives no accretions from the yolk, so far as at present known.

Mesoderm of Teleosts.—So far as the published accounts go the middle layer of bony fishes arises, as maintained by Balfour (*Comp. Embryol.*, II., 74), from the entoderm. Such appears to be the significance of Ryder's observation, *34*, 41, of A. Goette's, *9*, E. Ziegler's, *45*, Agassiz and Whitman's, *1*, and of others. For a good description, together with citations of conflicting authorities, see M. Kowalewski, *26*, 469–474. Apparently the blastodermic rim is turned under, and the turned-under portion yields the entoderm, and is intimately connected with the sheet of mesodermal cells, very much as in sharks; the mesoderm is several layers thick, and extends under the ectodermal blastoderm, gradually thinning out; the cells of the middle layer are at first closely compacted.

Mesoderm of Amphibia.—Here it seems also clearly established that the mesoderm arises from the entoderm, principally along and alongside the median line, as a sheet of cells with no cavity (cœlom) included between them; along the axis of the primitive streak and at the blastoporic margin the connection between the mesoderm and the entoderm is both evident and intimate (see Bellonci, *5*, Tav. II., for figures showing this point in the axolotl, and O. Schultze, *35*, for similar figures of *Rana fusca*). These facts have been recorded by so many observers that there can be little doubt or none of their entire accuracy (see the description

and cuts, *ante* p. 618). It may be considered as still uncertain whether the sheet of mesoderm receives accretions at its distal edge from the yolk cells (entodermic) upon which it rests. There usually is no sharp limit between the two, and therefore we must consider it probable that at first the mesoderm receives additions from the yolk; later on it is found divided from the vitelline cells, and after it has split off it probably grows independently. The growth of the mesoderm at first from the yolk has been found in Petromyzon by A. E. Shipley, *38*, 177–178 (of Studies), although in later stages the mesoderm is severed from the yolk.

In later stages the mesoderm is wanting in the median line, and thus constitutes two masses or two lateral sheets. This bilateral division is effected by the development of the medullary groove and notochord. The mesodermic connection with the entoderm is retained, but is double, owing to the division. Along the median dorsal line of the archenteron runs the strip of entoderm which forms the notochord; on each side of this strip runs the line of connection between entoderm and mesoderm. The study of this *secondary* condition has led many authors into the error of ascribing a double origin to the amphibian mesoderm, and inferentially to the vertebrate mesoderm in general. This brings us to the consideration of O. Hertwig's views, which form one of the chief supports of the "Cœlomtheorie" of the brothers Hertwig. For further discussion of this theory, see p. 893.

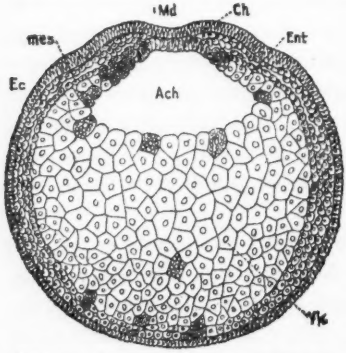


FIG. 23.—Axolote embryo: transverse section of an early stage; after Bellonci. *Ec*, ectoderm, *mes*, mesoderm; *Md*, medullary groove; *Ch*, notochord; *Ent*, entoderm; *Ach*, archenteron; *Yk*, yolk.

O. Hertwig, *12*, *13*, studied stages in which the notochord had appeared, and at this time, as O. Schultze, *35*, has shown, the primitive relations of the layers no longer exist, but Hertwig regarded the secondary arrangements in question as primary. He found no meso-

derm in the axial line above the notochord; at the edge of the notochord, where it joins the undifferentiated epithelial entoderm of the archenteron, there is on each side a groove which in cross sections appears as a notch (Fig. 23); the notch is of variable depth, is sometimes absent, and is a temporary feature. In the neighborhood of the furrow, alongside the notochord, the mesoderm is still intimately connected with the entoderm. These relations are believed by Hertwig to indicate that the mesoderm arises as two masses, which is not the case, and that each mass is really a diverticulum of the archenteron, the furrow being the mouth of the diverticular cavity. Hertwig's figures, *12*, Taf. XIII.–XIV., offer the plainest representations of the mesoderm in Triton as paired diverticula; but these figures [2] are evidently digramatic, and they must be termed inaccurate, I think, in the very respect which are essential to Hertwig's theory. This appears from the investigations of Götte, *10*, Bellonci, *5*, Bambeke, *3*, O. Schultze, *35*, and others; compare also K. Lampert, *27*. The reader may compare, for instance, Hertwig's Fig. 10, *l.c.* Taf. XIII., with Bellonci's Fig. 11, *l.c.* Tav. III. O. Schultze's detailed criticism, *l.c.* 344–349, of Hertwig's account seems to me entirely justified, and I accordingly accept it as a complete disproof. This criticism shows that Hertwig's conception is based upon insufficient and erroneous observations; insufficient because he did not investigate the early condition of the mesoderm, and failed to recognize the fugitive and unessential character of parachordal grooves; erroneous because the cavity in the mesoderm does not really communicate with that of the archenteron. There are other errors, which Schultze points out, and which are important.

We find in amphibia, at a certain stage, the axial (Rabl's gastrales) and lateral (Rabl's peristomales) mesoderm. The former is in the region of the completed concrescence, the latter around the edge of the anus of Rusconi. The former is connected with the entoderm alone; the latter with the ectoderm also, since the entoderm is connected with the ectoderm around the uncon-

[2] Some of them are reproduced in Hertwig's Lehrbuch der Entwickelungsgeschichte, sechstes Capitel.

cresced blastoporic rim. The connection with the ectoderm renders it possible that the middle layer receives cells from the outer layer, but there is no direct proof of this. When the concrescence is completed the mesoderm severs in the posterior axial region its connection with the entoderm, but retains awhile its connection with the outer germ-layer. The same phenomenon recurs in the amniota. It cannot, however, be taken to signify that the middle layer originates from the ectoderm, since at an earlier stage it is clearly entodermal.

Mesoderm of Sauropsida.—We may consider reptiles and birds together, since the early history of the mesoderm is very similar in the three classes. In *birds*, the exclusively entodermic origin of the mesoderm is in my opinion conclusively demonstrated by the researches of Duval, *8*, 104–117; the entoderm gradually thickens by migrations of its cells over a considerable axial area; the upper stratum of this thickened area separates off as the mesoderm, except that in the axial line it retains its connection with the entoderm; when concrescence takes place, the three layers are of course united in the axial line, and hence, as shown by Duval, the mesoderm is connected with the ectoderm. Hence we have two axial regions: 1°, the region of concrescence, characterized by the union of the mesoderm with the ectoderm, and known as the primitive streak; a little later the connection between the mesoderm and entoderm is lost in the posterior part of the streak, but retained in the anterior part; 2°, in front of the streak the region of completed concrescence known as the head-process, in which the mesoderm is united with the entoderm only. The secondary stage is the one best known through the investigations of many embryologists. It forms the starting of Rabl's investigations, *29*, 129–140, who accordingly failed to recognize the true origin of the mesoderm, having mistaken a secondary for a primary condition. After the mesoderm is once separated from the entoderm, it apparently receives no further cells from it, except in the axial region; it is not improbable that along the primitive streak cells are also thrown off from the ectoderm and added to the mesoderm.

In *reptiles*, so far as our present unsatisfactory knowledge enables us to judge, the development is similar; that is to say,

the mesoderm arises by delamination from the entoderm, but remains connected with it along the axial line in front, *i.e.*, in the head-process it remains connected with the entoderm only, but along the primitive streak it becomes secondarily connected with the ectoderm. After its delamination the mesoderm expands independently of other germ-layers, except along the axis. That the relations are like those in birds has been shown clearly by Strahl, *39*, and also by Weldon, *43*, whose figure is reproduced (*ante* p. 714, Fig. 22, A). The intimate connection of the mesoderm with the entoderm at the blastodermic rim before concrescence is sufficiently established by Kollman, *23*, 403–406, though his conception that this part of the mesoderm is a separate structure, which he terms akroblast, renders it difficult to follow certain parts of his description. C. K. Hofmann may also be cited, though his account (Bronn's Thierreich, Reptilien, p. 1881) is of doubtful accuracy in several respects. L. Will, *44*, 1127, finds that in the Gecko the mesoderm is united with the entoderm in the head-process, but omits to describe its exact connection with the primitive streak; the stages showing the *origin* of the mesoderm he does not mention. The processes involved will undoubtedly be understood as soon as the concrescence of the axis has been worked out,—a fundamental question which as yet not a single investigator has heeded.

Mesoderm of Mammals.—In this class, according to the best recent investigations, the mesoderm appears to have a distinctly two-fold origin. According to Bonnet, *6*, 196, part of the mesoderm grows out from Hensen's knot, at a time when the knot is a thickening of the ectoderm, and has not yet acquired any connection with the inner layer; another portion is produced peripherally (Fig. 18 *ante* p. 705) by delamination from the inner layer; the two anlages grow toward one another, and unite into one continuous mesoderm, in which all trace of the primitive double origin is obliterated. Kölliker has recorded (Würzburger Festschrift) the outgrowth of the mesoderm from Hensen's knot in the rabbit, and his statement has been confirmed by Fr. Carius, *7*, 17. In later stages we find the relations of the layers similar to those in Sauropsida, there being a head-process with the mesoderm

connected axially with the inner layer, and a primitive streak in the front part of which the three layers are connected axially, and in the hinder part of which the middle layer is connected with the outer layer only. This stage is quite well known; cf., Heape, *11*, on the mole; Bonnet on the sheep, *6*; Kölliker on the rabbit (*Grundriss*); Selenka on the opossum, *37*; Lieberkühn, *28*, and others; especially the very careful descriptions of the rabbit's layers by C. Rabl, *29*.

Now, we do not yet understand the homologies of the mammalian blastodermic vesicle, hence we cannot explain the peculiar relations of the mesoderm to Hensen's knot, as the homology of the knot is unknown. However, since mammals are in all respects related to the Sauropsida, and especially since there is a close likeness between the subsequent stages of the two classes, it is probable that the origin of the mammalian mesoderm will be shown ultimately to be essentially the same as in reptiles. At present it seems to me impossible to offer any satisfactory interpretation of the observed double origin of the mammalian mesoderm.

The Vertebrate Type of Origin of the Mesoderm.—The preceding paragraphs show that in all classes of vertebrates the origin of the mesoderm is essentially the same, *except* in the mammals. The relations in the mammals we do not understand. In the non-mammalian vertebrates the mesoderm first appears as a thickening of the entoderm over a not inconsiderable area around the concrescing blastodermic rim, and it becomes separated from the entoderm by the gradual parting of the upper cells to form the true mesoderm from the lower cells or permanent entoderm; this delamination does not take place next the blastodermic rim (or after concrescence in the axial line), hence in the region of the primitive streak the three layers may be connected for a time; further in the prolongation of the axis in front of the streak the mesoderm does not separate from the entoderm, thus forming the head-process. It is important to note that the mesoderm arises over a considerable area during the same period; that its formation may be more or less advanced before concrescence of the rim; and that after concrescence it stretches across the axis of

the embryo between the ectoderm and entoderm, thus becoming a continuous sheet or layer. This fact, that the mesoderm is a single anlage, needs to be specially emphasized. So far as known to me, there is not a single vertebrate which has been shown to lack this stage; but on the contrary, its occurrence is established for all classes, and by so many observers, that we may well assert that there are few facts in embryology better established. Later on the mesoderm becomes divided in the axial line, and a too exclusive consideration of this secondary condition has led to several theories of the mesoderm, which would hardly have been brought forward had their authors not neglected to take into account the earlier condition of the middle layer. Some of these theories are discussed below.

After its delamination the mesoderm is a distinct layer, and grows independently, receiving no accretions from the other layers, except in the axial line, where it receives cells from the entoderm, and in the region of the primitive streak. The edge of the expanding sheet of mesoderm is free, as has been pointed out in the previous chapter, resting upon the yolk, but not fused with it. It is, therefore, it seems to me, impossible to admit that there is a peripheral ingrowth of tissues arising from the yolk, and entering the mesoderm to form the blood, etc. (compare below, *Theories of the Mesoderm*).

The origin of the mesoderm in Amphioxus and invertebrates differs in many respects from that in vertebrates, and no attempt to establish the homologies of the processes throughout the animal kingdom has been successful. I accordingly merely give a brief notice of the mesoderm of Amphioxus, adding a mention of the mesodermal bands of invertebrates.

The ovum of Amphioxus is discharged from the body and impregnated externally; it is about 0.105 mm. in diameter, and as it contains only a small amount of yolk undergoes a holoblastic segmentation, which results in a well-marked blastula stage (Fig. 24), followed by a gastrula stage. The gastrula elongates, the blastopore remaining open at the posterior extremity. Differentiations now take place, by which the ectoderm forms the axial anlage of the nervous system, and the entoderm pro-

duces the notochord and the mesoderm; the three processes going on simultaneously. The accompanying Fig. 24 represents a cross section of a larva with segments. The ectoderm, *Ec*, everywhere bounds the section; on the dorsal side a portion of the ectoderm has been separated off to form the medullary plate, *Md*, above which is a small cavity. The cavity, *In*, of the archenteron is irregular, but symmetrical in outline; the entoderm bounding it can be separated into four parts: 1°, the lower portion, which forms the permanent entoderm, *Ent;* 2°, the upper median portion, which becomes the notochord, *Ch*; 3°, 4°, two lateral portions, constituting the diverticula, *Ms;* each diverticulum is a separate pouch, and as the development progresses, there are formed a series of pairs of pouches, stretching on either side along the notochord; later the pouches separate altogether from the archenteron, each becoming a closed sack; the first pair of pouches, however, retain their connection for a considerable period with the archenteron, and have been described by older writers as glandular organs. The development of the pouches is, with the exception noted, most advanced anteriorly, and as we go tailwards the pouches are less and less advanced in development, until, as shown in Fig. 25, they merge into the general entoderm as a band of cells, *Mes;* the last of which is the "mesoblast," *Mb*, a large granular cell, quite distinct from the remaining cells of the band or pouches. The pouches are the primitive segments (Ursegmente, mesoblastic somites of Balfour). In Amphioxus, then, the mesoderm arises from the entoderm along two lines, and is divided into paired hollow segments before it is separated from the mesoderm. Some writers, especially the brothers Hertwig, think this process of development to be primitive, and that the vertebrate type is derived from it. In true ver-

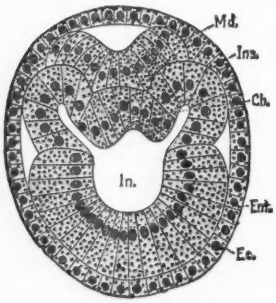


FIG. 24.—Transverse section of an Amphioxus embryo; after Hatschek. *Md*, medullary plate; *Ch*, notochord; *Ent*, entoderm; *Ec*, ectoderm; *In*, archenteric cavity; *Ms*, mesodermic segments.

tebrates the mesoderm arises on each side, but also in the axis, and becomes two masses, when the medullary groove and notochord appear. In Amphioxus the medullary plate and notochord appear very early, and the division of the mesoderm may be due to that fact. Amphioxus is undoubtedly a lower type, but whether it really preserves the older type of development in its purity is doubtful; indeed, it is probably a tunicate rather than a vertebrate.

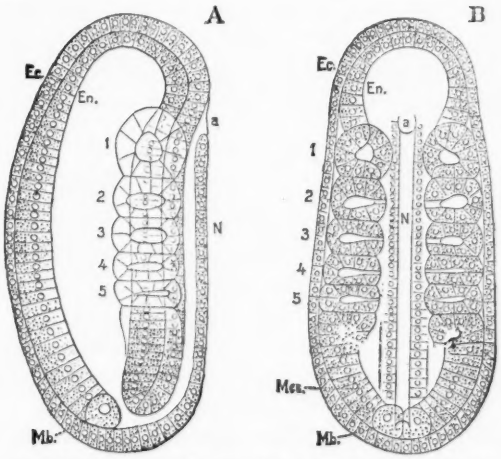


FIG. 25.—Amphioxus embryo; after Hatschek. A, side view; B, ventral view. *Ec*, ectoderm; *En*, entoderm; *a*, neuropore; *N*, nervous system; *Mes*, mesoderm; *Mb*, mesoblast; *1–5*, segments.

Hatschek, in a series of brilliant investigations, has shown that in many bilaterally symmetrical invertebrates the mesoderm arises as two bands of cells, which subsequently divide into a series of closed sacks (segments), and which, during their own formation, terminate each in a single large posterior cell (mesoblast), which throws off cells to add to the mesodermal band (germ-band, Keimstreif). This "mesoblast" by its appearance and position appears to be a derivative of the entoderm. As a matter of speculation, we may assume that in Amphioxus we have the germ-bands, but characterized by an exceedingly precocious segmentation. We can further assume that in vertebrates

we have the germ-bands also, but that they are modified, 1°, by the loss of the distinct terminal mesoblast; 2°, by precocious fusion in the axial line; and 3°, by extremely retarded segmentation. A great deal may undoubtedly be said in favor of these two assumptions, which together constitute the only "THEORY OF THE VERTEBRATE MESODERM" which of the many theories which have been advanced is at all likely, in my opinion, to prove of permanent value.

Expansion of the Mesoderm.—After the mesoderm is once formed as a distinct layer, without connection with the primitive layers except in the axial line, it expands independently,—that is, by the proliferation of its own cells. During its early expansion

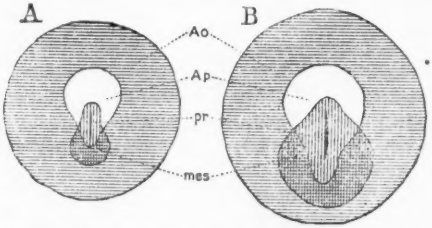


FIG. 26.—Diagrams of the embryonic area of the chick. *Ao*, area opaca; *Ap*, area pellucida; *pr*, primitive streak; *mes*, mesoderm. After Duval.

the mesoderm assumes in all amniota a definite series of characteristic outlines. It is at first pear-shaped (Fig. 26, A), the anterior end being pointed; it extends a short distance only in front of the primitive streak, and is widest a little distance behind the area pellucida, *Ap*. The same stage is found in mammals (see Kölliker, *Grundriss*, p. 93, and Fig. 71). The condition in the chick at about the twentieth hour of incubation is indicated by Fig. 26, B, drawn on the same scale as A, and at the close of the first day by Fig. 27. In the last-mentioned figure it will be noticed that the mesoderm is expanding unequally in front, having sent out two lateral wings, which leave a median space between them without mesoderm. These wings continue their growth, and finally meet in front, so that in the anterior part of the area pellucida there is a small tract without any mesoderm, although there is mesoderm all around it. This tract is the pro-

amnion, of which I shall give a fuller history elsewhere. The expansion does not take place by any means with the exact regularity indicated by Figs. 26 and 27, but, on the contrary, in birds, as shown by Zumstein, *46*, the outline of the middle layer is always irregular and more or less asymmetrical. Although there are not yet many observations available as to the outline of the growing mesoderm, yet it is probable that the preceding description is essentially correct, not merely for birds but for all amniota. It is certainly so for the rabbit (Van Beneden et Julin, *4*).

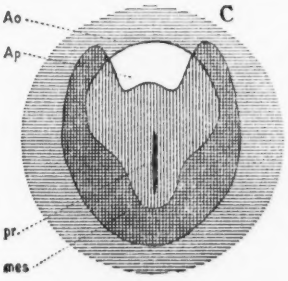


FIG. 27.—Diagram of the embryonic area of a chick. *Ao*, area opaca; *Ap*, area pellucida; *pr*, primitive streak; *mes*, mesoderm.

II. FORMATION OF THE CŒLOM.

Early in the course of development there appear in the mesoderm two large cavities, one on each side, which together constitute the *cœlom* or embryonic body cavity. In the adult mammal the cœlom is represented by the pericardial, pleural, and abdominal cavities; the cœlom also gives rise to the cavities of the muscular segments (protovertebræ), and probably also to certain tubular parts of the urogenital system. But, although its subsequent changes are complex, when it first appears the cœlom consists of a pair of fissures in the mesoderm.

Only one precise account of the development of the cœlomatic fissures is known to me, namely, that of Bonnet, *6*, 202, for the sheep at about thirteen days. Around the embryo, at some distance from the axis, there appear a series of irregular fissures of rounded or elongated form, which may in part open on the mesodermic surface; gradually the fissures enlarge and fuse, at the same time becoming more closely bounded by the mesodermic cells; thus there arises a continuous cavity in the mesoderm, which is for a time crossed by cells and cell processes; meanwhile the cells which are loosely put together form a compact layer of epithelium bounding the cavity, which we can now designate as the *cœlom*, or primitive body cavity. By similar

processes the cœlom grows toward the axial region, but never penetrates it, the primitive streak and head-process never developing a cœlom. The changes which have taken place have now divided the mesoderm into two tissues: 1°, the *mesothelium* or epithelial lining of the body cavity; 2°, the *mesenchyma* comprising all the non-epithelial mesoderm. Whether in all cases the cœlom begins as a series of small spaces, which subsequently fuse, we are unable to say; but it is my no means improbable that such is the case. It is, I think, also probable that the cœlom begins always to appear at a little distance from the embryo, and spreads both centripetally and centrifugally. In the sheep the large size of the cœlomatic cavity is connected with the precocious development of the amnion.

Of other vertebrates we can say only that the cœlom appears, and is at first merely a narrow fissure. It divides the mesoderm into an upper leaf (Hautfaserblatt) and an inner or lower leaf (Darmfaserblatt); the former may be called the *somatic*, the latter the *splanchnic mesoderm*, as proposed by Balfour. The upper leaf lies close against the ectoderm; the two layers together form the *somatopleur*, or body wall. The lower leaf lies close against the entoderm; these two layers together form the *splanchnopleur*, or wall of the alimentary tract. Both the somatic leaf of mesoderm and the splanchnic comprise mesothelium and mesenchym; axially the two layers become continuous, both with one another and with the axial mesoderm. The mesothelium continues for some time to throw off cells, which add themselves to the mesenchym, but except for this the two tissues have each an entirely separate history, and the adult tissues derived from them form two well-defined and natural groups.

The morphology of the cœlom is so important that it is difficult to understand why so many investigators have slurred over the question of its embryonic development. Exact observations on its first appearance and on the first stages of its expansion in various types are urgently needed, and would certainly do more than anything else to throw light on the still obscure problem of the origin of the mesoderm.

Theories of the Mesoderm.[3]—From the time of Von Baer's Entwickelungsgeschichte, of which the first part appeared in 1828, until 1868, when W. His's great monograph on the chick, *16*, was published, embryologists recognized the three layers, and regarded the mesoderm as a natural unit. His led the way to our present conception by a little-known article, *15*, on the membranes and cavities of the body, and his monograph, *16*, above mentioned fully established the necessity of recognizing two main groups of mesodermic tissues. Accordingly he divided the mesoderm into two parts, the *archiblastic*[4] and *parablastic*, corresponding respectively essentially to mesothelium and and mesenchyma. Under archiblast, His included not only the mesothelial tissues proper, but also the smooth or organic musculature; under parablast the mesenchymic tissue, except the smooth muscle. The terms used corresponded to his theory of the origin of the two parts of the mesoderm, for he believed that the archiblast arose in the axial region, and was contained in the embryo from the start, while the parablast arose peripherally, and grew in towards the embryo, a conception which was perhaps suggested by the appearance of the blood-vessels first outside the embryo proper. Seeking still further for the source of the supposed peripheral parablast, he believed he had found it in the germinal wall. The study of the relations of the wall in the chick induced him to think that the elements of the white yolk became parablast cells; moreover, the study of the hen's ovary led him to the conclusion that the white yolk was developed from the granulosa cells, and that these cells arise from leucocytes. He thus traced back the parablastic cells to maternal leucocytes. It has been shown that the granulosa cells are not leucocytes, and that the granulosa cells do not enter the ovum; the white yolk-grains never become cells, for it has been proved that all nuclei of the segmentating ovum come from previous nuclei, and lie in protoplasm, not in the yolk-grains; and finally it has been shown in this chapter that the mesoderm arises, as a whole, not from double sources. Professor His's views as to the origin of the parablast

[3] See *ante* p. 880.

[4] His's archiblast includes the ectoderm, entoderm, and archiblastic mesoderm.

must, in my judgment, be given up; but this is no reason for overlooking, as certain writers have done, the fundamental significance of the distinction drawn between the two primary groups of mesodermic tissues. Subsequent research has made only one important change necessary, namely, the transfer of smooth musculature from one group to the other. In view of this change and of the fact that parablast has been used with various other meanings, and of the unaptness of His's names, since we renounce the theory they correspond to, it will be well to use exclusively the newer terms mesothelium and mesenchyma.

The parablast theory has been defended by His, *17*, and modified by him, *18*. At present he holds to the distinction originally drawn, but is inclined to withdraw his hypothesis of the origin of the parablast. A number of writers have agreed with His as to the separate peripheral development of the mesenchyma (parablast). Among those may be mentioned Rauber, *30*, *31*, and several authors who have dealt with the development of the blood. The most important of the disciples of His is Kollmann, who, in a series of articles, *22*, *23*, *24*, *25*, has maintained the double origin of the mesoderm. Of these papers the most important is that on the "Randwulst," or germinal wall, of the structure of which in the chick it gives an excellent description. Kollmann regards the germinal wall not as a part of the entoderm, but as a distinct organ composed of segmentation spheres, and destined to produce blood-vessels with blood, and probably also connective tissue; this peripheral anlage (Randkeim) he designates as *acroblast*, and the single cells derived from it he names *poreuten*. Waldeyer, *42*, has accepted the parablast theory, but with a modification by which he seeks to reconcile conflicting observations. His article is written with characteristic clearness and exhaustive mastery of the literature, and will be found especially valuable by those who wish to pursue this subject further. Waldeyer distinguishes between the primary and secondary segmentation; the former producing the ectoderm, entoderm, and archiblastic mesoderm; the latter occurring later, and giving rise to the parablast. This remnant of the ovum in holoblastic ova consists of cells; in meroblastic ova of

egg protoplasm, which has its cell division (segmentation) retarded, and the cells, whether early or tardily produced, immigrate into and between the germ-layers already developed.

The opposition to the parablast theory is the sum of numerous observations which, as pointed out in the previous part of this chapter, prove, it seems to me, that the mesoderm arises in all vertebrates (except mammals?) as a unit, and subsequently separates into mesothelium and mesenchyma. The leading opponent of the separate origin of the parablast is Kölliker, in both his text-books (Entwickelungsgeschichte, etc., and Grundriss), and in separate articles (see especially *19*, *20*, and his criticism, *21*, of Kollmann). I agree with Kölliker that it has been sufficiently demonstrated that the "acroblast" belongs to the entoderm, and that after delamination of the mesoderm the acroblast is transformed into the epithelium of the yolk-sac; for a conclusive demonstration that this is so in reptiles, see H. Strahl, *40*.

The *cœlom theory* of the brothers Hertwig includes a fundamental modification of the parablast theory. The main features of the cœlom theory are not original with the Hertwigs, but may be found in previous writers. Nevertheless, they were the first to present the theory in a complete formula, and with a backing of facts, both new and collected from others, so extensive as to compel attention. In justice to E. Ray Lankester it must be stated that he is really the author of the cœlom theory, having, in 1877 (*27*, *A*), published the hypothesis that the cœlom is derived from the archenteron, and that the mesoderm of vertebrates represents solid entodermal diverticula. It is unfortunate that the Hertwigs have not made due acknowledgment of what they owed to Lankester and others. They made a series of investigations on the germ-layers of various representatives of the animal kingdom, and presented their general results in a comprehensive article (O. and R. Hertwig, *14*). O. Hertwig has again expounded the theory in his text-book of embryology. The cœlom theory consists of two parts: 1°, the cœlom is formed by diverticula of the archenteron and its lining; the mesothelium is part of the entoderm; 2°, the mesenchyma consists of cells thrown off by the germ-layers, and is essentially distinct from the

mesothelium. The value of this theory lay in the clearness of its formulation, thus facilitating discussion, and also in its bringing out the difference more clearly between the epithelial and the non-epithelial portions of the mesoderm. As we have seen, there is no evidence of a character to render even probable that part of the cœlom of vertebrates represents archenteric diverticula; the whole mesoderm appears as a single germ-layer, which is subsequently differentiated into mesenchyma and mesothelium. Hence both essential parts of the cœlom theory are inapplicable, at least in the present state of our knowledge, to vertebrates. For further discussion of the difficulties of the Hertwigs' theory, see Rabl, *29*, 198–202. The Hertwigs recognized the significance of the parablast, and added the important rectification, which Flemming's observations had already rendered necessary, of separating the smooth muscles from the striated skeletal muscles, a separation the propriety of which was wrongly questioned by Balfour (*Comp. Embryol.*, II., 359). By this advance the two groups of mesodermal tissues became properly delaminated.

C. Rabl's theory of the mesoderm is based, it seems to me, wholly upon his failure to understand the law of concrescence. That the mesoderm appears (perhaps in all vertebrates) while concrescence is going on is well ascertained; consequently there is an axial mesoderm (Rabl's "gastrules mesoderm") where concrescence has taken place, and a lateral mesoderm (Rabl's "peristomales mesoderm") in the part of the blastodermic rim which has not concresced. Until Rabl proves that his "peristomales" mesoderm does not become axial mesoderm in later stages, his theory can have no standing. His memoir brings out one point of very great importance for the elucidation of the early stages of vertebrates, namely, that the "peristomal" mesoderm—in other words, that of the blastodermic rim in selachians and of the lips of the anus of Rusconi in amphibians—is represented in the amniota by the mesoderm of the primitive streak. If this interpretation, which is much strengthened by L. Will's researches on the Gecko, *44*, be verified, then the primitive streak is the homologue in amniota of the anus of Rusconi, and is the region where concrescence is incomplete; the head-process is

then the part where concrescence is finished. This concords with the observed fact that the head-process grows at the expense of the primitive streak, as it would do if concrescence continued.

The So-called Parablastic Nuclei of the Yolk.—In meroblastic vertebrate ova, after the embryo is formed, there appear in the yolk near its surface, underneath the extra embryonic blastoderm, peculiar large nuclei, which are commonly designated as the parablastic nuclei. The following description applies to Pristurus.[5] The extra embryonic ectoderm is a rather thin, much-flattened epithelium lying close to the yolk; below the ectoderm is the superficial layer of the yolk, a broad stratum of protoplasm with scattered small yolk-granules; a little deeper down a row of irregular vacuolar spaces, and again, a little deeeper, a layer of very big nuclei, each with a distinct intra-nuclear network and several deeply stained nucleoli; the nuclei vary in size, being from 2–5 times the diameter of the nuclei in the embryo. The upper part of the protoplasmatic stratum contains numerous small and a few larger yolk-grains, and contains near and under the embryo small nuclei; the middle part of the stratum contains the vacuoles, the big nuclei, and but few yolk grains; the deepest part contains larger granules, and merges gradually into the yolk proper (see also His, *18*, *75*, and Rückert, *32*). Rückert designates these nuclei as "*Merocytenkerne*," and the cells which they represent as "*Merocyten*." The special function of the protoplasmic layer appears to be the assimilation of the nutritive yolk. Rückert also maintains, but without proper evidence, it seems to me, that merocytes become cells, some of which join the ectoderm, some the entoderm, and yet others the mesenchyma. In the Sauropsida we find similar nuclei and similar relations of the nucleated layer, but in this type the protoplasmic layer becomes the epithelium of the yolk (see especially H. Strahl, *40*), and I consider it probable that these parablast nuclei in all meroblastic ova belong to the vitelline entoderm.

In holoblastic mammalian ova the vitelline entoderm is cellular, and no nuclei are known similar to the large "parablastic" nuclei of mesoblastic ova.

[5] From sections in the collection of Prof. His, which he generously permitted me to study.

AUTHORITIES CITED.

1. AGASSIZ, A., and WHITMAN, C. O. On the Development of Some Pelagic Fish Eggs. Preliminary notice. Proc. Am. Acad., XX., pp. 23–75, 1 Pl., 1884.

2. BALFOUR, F. M. A Monograph on the Development of the Elasmobranch Fishes. London, pp. 295, Pls. I.–XX., 1878.

3. BAMBECKE, V. Recherches sur le Développement du Pélobate Brun (*Pelobates fusus* Wagl.). Mem. Couron. Belg. Acad., XXXIV., 66 pp., 5 Pls., 1868.

4. BENEDEN, E. VAN, and JULIN, CHARLES. Recherches sur la Formation des Annexes Foetales chez les Mammifères (Lapin et Cheiroptères). Arch. Biol., V., fasc. 3, 369–434, Pls. XX.–XXIV., 1884.

5. BELLONCI, GUISEPPE. Blastoporo e linea primitiva dei Vertebrati. R. Acad. Lincei. Ser. 3, XIX., CCLXXXI., pp. 45. Taf. I.–VI., 1884.

6. BONNET, R. Beiträge zur Embryologie der Wiederkauer gewonnen am Schafen. Arch. f. Anat. u. Entwick., Anat. Abth., 170–230. Taf. IX.–XI., 1884.

7. CARIUS, FR. Ueber die Entwickelung der Chorda und der Primitiven Rachenhaut bei Meerschweinchen und Kaninchen. 8vo, pp. 33. Taf. I., Marburg, 1888.

8. DUVAL, MATTHIAS. De la Formation du Blastoderme dans l'oeuf d'oiseau. Ann. Sci. Nat. Zool., XVIII., Ser. 6, 1–208, Pls. I.–V., 1884.

9. GOETTE, A. Der Keim des Forelleneies (Beiträge zur Entwickelungsgeschichte der Wirbelthiere). M. Schultze's Arch. f. Mikr. Anat., IX., 679–708. Taf. XXVII., 1873.

10. ——. Die Entwickelungsgeschichte der Unke (*Bombinator igneus*) als Grundlage einer Vergleichenden Morphologie der Wirbelthiere. 8vo, p. 964. 4to, Atlas. Taf. XXII., Leipzig, 1875.

11. HEAPE, W. The Development of the Mole (*Talpa europea*). The Formation of the Germinal Layers, and Early Development of the Medullary Groove and Notochord. *Q. J. M. S.*, XXIII., 412–452, Pls. XXVIII.–XXXI. Studies Morph. Lab. Cambridge, II., 29–75, Pls. VI.–IX., 1883.

12. HERTWIG, O. Die Entwickelung der mittleren Keimblattes der Wirbelthiere. Jen. Z., XV., 286–340. Taf. XII.–XV., 1882.

13. ——. Die Entwickelung des mittleren Keimblattes der Wirbelthiere. Jena Z. Natur., XVI., 247–328. Taf. XIV.–XVIII., 1883.

14. HERTWIG, O. u. R. Die Coelom theorie: Versuch einer Erklärung des mittleren Keimblattes. Jena Zeitsch., XV., 1–150. Taf. I.–III., 1881.

15. HIS, W. Die Häute und Höhlen des Körpers. Basel, 34, 1865.

16. ——. Untersuchungen über die erste Anlage des Wirbelthierleibes. Die erste Entwickelung des Hühnchens im Ei. Leipzig, 237 pp., 12 Taf., 1868.

17. ——. Der Keimwall des Hühnereies und die Entstehung der Parablastischen Zellen. Zeitsch. f. Anat. u. Entwick., I., 274–287, 1876.

18. ——. Die Lehre von einem Bindesubstanzkeim (Parablast). Rückblick nebst Besprechung einiger neuerer Entwickelungsgeschichtlicher Arbeiten. Arch. f. Anat. u. Phys., Anat. Abth., 62–108, 1882.

19. KÖLLIKER, A. Ueber die Nichtexistenz eines Embryonalen Bindegewebskeims (Parablasts). Sitzb. Phys. Med. Ges. Würzburg, 14–18, 1884.

20. ——. Die Embryonalen Keimblätter und die Gewebe (und Nachtrag). Z. Z., XL., 179–213. Taf. XI.–XII., 336–357, 1884.

21. ——. Kollmann's Akroblast. Z. Z., XLI., 155–158, 1885.

22. KOLLMANN, J. Der Mesoblast und die Entwicklung der Gewebe bei Wirbelthieren. Biol. Centrabl., III., No. 24, pp. 737–747, 1884.

23. ——. Der Randwulst und der Ursprung der Stutzsubstanz (und Nachwort). Arch. f. Anat. u. Phys., Anat. Abth., 341–434. Taf. XVI.–XVIII., 461–465, 1884.

24. ——. Gemeinsame Entwickelungsbahnen der Wirbelthiere. His's Arch., 279–306. Taf. XII., 1885.

25. ——. Ueber Gemeinsame Entwickelungsbahnen der Wirbelthiere. Zeit. Wiss. Zool., XLI., 517–524, 1885.

26. KOWALEWSKI, MIECZ VON. Ueber die ersten Entwickelungsprocess der Knochenfische. Z. Z., XLIII., 434–480. Taf. XVII., 1886.

27. LAMPERT, K. Zur Genese der Chorda Dorsalis beim Axolotl. Sitzb. Phys. Med. Soc. Erlangen, 37–57. Taf. I., 1883.

27*a*. LANKESTER, E. RAY. Notes on Embryology and Classification. *Quar. Jour. Micr. Sci.*, XVII., 399–454, Pl. XXV., 1877.

28. LIEBERKÜHN, N. Ueber die Chorda Sangethieren. Arch. f. Anat. u. Phys., Anat. Abth., 399–438. Taf. XX.–XXI., 1882.

29. RABL, CARL. Theorie des Mesoderms. Morph. Jb., XV., 113–250. Taf. VII.–X., 1889.

30. RAUBER, A. Ueber den Ursprung des Blutes und der Bindesubstanzen. Sitzb. Natforsch. Ges., Leipzig, 1877.

31. ——. Die Entwickelung der Gewebe und die Sitz. Natforsch. Ges., Leipzig, 1883.

32. RÜCKERT, J. Zur Keimblattbildung bei Selachiern Ein Beitrag zur Lehre vom Parablast. 8vo, pp. 58, München, 1885.

33. ——. Ueber die Anlange des Mittleren Keimblattes und die erste Blutbildung bei Torpedo. Anat. Anz., II., No. 4, pp. 97–112; No. 6, 154–176, 1887.

34. RYDER, JOHN A. A Contribution to the Embryology of Osseous Fishes, with Special Reference to the Development of the Cod (*Gadus morrhua*). Ann. Rept. Com. Fish and Fisheries for 1882. Pls. I.–XII., 1884.

35. SCHULTZE, OSKAR. Die Entwickelung der Keimblätter und der Chorda Dorsalis von Rana fusca. Zeit. Wiss. Zool., XLVII., 325–352. Taf. XXVIII.–XXIX., 1888.

36. SCHWARZ, D. Untersuchungen der Schwanzendes bei Embryonen der Wirbelthiere. Zeit. Wiss. Zool., XLVIII., Heft 2, 191–224. Taf. XII.–XIV., 1889.

37. SELENKA, E. Studien über Entwickelungsgeschichte der Thiere, Heft IV. Das Opossum (*Didelphys virginiana*). 1 Hälfte, Wiesbaden, 1886.

38. SHIPLEY, ARTHUR E. On Some Points in the Development of *Petromyzon fluviatilis*. *Quar. Jour. Micr. Sci.*, XXVII., 325–370. Pls. XXVI.–XXIX. Studies Morph. Lab. Cambridge, IV., 173–218, Pls. XVIII.–XXI., 1888.

39. STRAHL, H. Beiträge zur Entwickelung der Reptilien. His's Arch., Anat. Abth., 1–43. Taf. I., 1883.

40. ——. Die Dottersackswand und der Parablast der Eidechse. Z. Z., XLV., No. 1, 283–307. Taf. XVI., 1887.

41. SWAEN, A. Etudes sur le Développement de la Torpille (*Torpedo ocellata*). Arch. de Biol., VII., 537–585, Pls. XIV.–XVI., 1887.

42. WALDEYER, W. Archiblast and Parablast. Arch. f. Mikr. Anat., XXII., 1–77. Z. thiel Allgemeine Anatomie, 1883.

43. WELDON, A. B. Note on the Early Development of *Lacerta muralis*. *Q. J. M. S.*, XXIII., 134–144, Pls. IV.–VI. *Also in* Sedgwick's Studies, II., 1–12, Pls. I.–III., 1883.

44. WILL, L. Bericht über Studien zur Entwickelungsgeschichte von *Platydactylus mauritanicus*. Sitzb. Kon. Preus. Akad. Wiss. Berlin, LII., 1121–1228, 1889.

45. ZIEGLER, H. E. Die Embryonale Entwickelung bei Salmo salar. Freiburg (Diss.), 1882.

46. ZUMSTEIN, J. J. Ueber das Mesoderm der Vogelkeimscheibe (Huhn und Ente). 8 vo., p. 56. Bern (Inaug. Diss.), 1887

THE EVOLUTION OF MIND.

BY E. D. COPE.

BEFORE entering on this subject we must consider the nature of mentality. Mental acts display a great range from simple to complex. An attempt is made to exhibit their relations in the following table.

Class I. Perceptions (presentations).
Class II. Ideas (representations).
Division A. Memory of Perceptions.
Division B. Affection (taste, emotion).
Division C. Imagination.
Division D. Ratiocination.
Method A. Conception (generalization).
1st Grade.
2d Grade.
3d Grade, etc., etc.
Method B. Induction (inference).
1st Grade.
2d Grade.
3d Grade, etc.
Method C. Deduction (predication).
Division E. Will.

The divisions of this table are not mutually exclusive. With regard to the methods of Ratiocination as above enumerated, it is to be noted that Induction and Deduction are distinct in kind from Conception, and are based on the latter, as well as on the simple Memory of Perceptions (Division A). While Conceptions are classifications, Induction and Deduction follow the Memory of Perceptions whether classified or simple. Will is expressed in action induced by any of the faculties embraced in the four preceding divisions.

In this chapter I will first compare the mental faculties of man and the animals below him, and will then consider their progressive evolution.

I. CONSCIOUSNESS.

The faculties of perception or observation, form the primary division of mental processes, and the most simple. They include those of general sensation and of special sensation. To the latter belong smell, hearing, taste, and sight; to the former, touch, temperature, muscular sense, etc. It may be inquired, What have these functions in common with the affections, the intelligence, and the will? They have the important characteristic in common, that they are all forms of consciousness, or self-knowledge. All of these functions are forms of consciousness, although some of the representative faculties may become automatic and unconscious after education. Consciousness, then, is the one common property of all mind; and, from the point of view of the evolutionist, progressive development of mind is the advance from the simpler to the more complex, or from the generalized to the specialized forms of consciousness. Mind, then, in this general sense, embraces every and all kinds of metaphysical condition, including the unconscious derivatives of conscious antecedents. Of this latter mental type more will be said later.

That many of the higher animals possess mental faculties which must be referred to the divisions of the intelligence and the affections, is evident to every person who is familiar with the animals themselves. That the simpler affections or "instincts" are present in animals very far down in the scale, is also obvious. That special senses exist in animals as low down as the Cœlenterata has been shown by Dr. Romanes and Prof. Eimer. General sensation is probably present in still lower forms of life; but which of them possess this simplest form of consciousness, and which do not, is at present very difficult to state. We may, however, form an estimate of probabilities in the case by observing the movements of Protozoa under stimuli, as well as those of the spermatozoöids and phagocytes, which have a free existence within the bodies of all but the lower forms of life.

The test of the presence of conciousness as the condition of the performance of an act is to be found in the nature of the act. Consciousness may be supposed to be necessary to the performance of an act which displays a definite relation to the satisfaction of some need of the animal; but such an act does not necessarily prove that consciousness is present at the moment of action. It is well known that designed acts may be performed by the higher animals which have been deprived of their nervous sensory centers. Thus many vertebrates respond to stimuli applied to the extremities of their peripheral nervous system after the removal of the brain; such movements are entirely appropriate to the stimulus, being directed to the removal of the source of the irritation. The presence of consciousness (or sensation) cannot be predicated on movements of this kind. In fact, many kinds of movements of considerable complexity are unconsciously performed by man with uninjured sensory centers, in consequence of their subjection to the process of automatization, which is education, of the centers. By continued repetition a given movement may be learned, so that consciousness is not necessary to its performance, as for instance, knitting and reading aloud. Walking and other comparatively simple movements may be still more readily performed in unconsciousness. It is certain that even some of the higher functions of the brain, as classification, may be so performed. On account of these well-known phenomena it is supposed by a class of thinkers that consciousness has not been necessary to the original performance of any act, no matter how complex it may be, and no matter how evident the design. They suppose that action has been promiscuous or multifarious, and that natural selection has preserved those individuals whose movements chanced to be beneficial, and that those whose movements have been of a useless or injurious kind have been destroyed.

There are two objections to this explanation of the origin of designed movements. The first is, that in all cases where we have the opportunity of observing the origin and development of such acts, we find that they have to be learned, and that they only become automatic after a more or less prolonged period of education. This process of education is one that involves the pres-

ence of consciousness, or the experience of pleasures and pains, as consequences of movements. The movements are first performed under the experience of the necessity of securing the one, and of avoiding the other; a desire which is a condition of consciousness wherever it exists. Another objection to the explanation of the origin of designed acts by fortuity and natural selection, is identical in character with that which has been urged against the similar explanation of the origin of permanent variations of structure. The chance of the accidental performance of profitable movements among all possible movements, is very small; and the chance of the repetition of such movements by a sufficiently large number of individuals to cause them to be preserved by reproduction and inheritance is much smaller. In order to preserve such movements so that they should become habitual in a single individual, it would be necessary they they should be performed by it frequently,—a probability which diminishes directly in proportion to the frequency required to produce that result. Thus our negative knowledge of this subject agrees with our positive knowledge in impressing us with the extreme improbability of a single habitual designed act having arisen and been perpetuated by chance.

It is sometimes doubted whether consciousness can exist in such simple beings as the Protozoa. But this doubt seems to be unnecessary after a consideration of the organization of such higher forms of life as we know to be conscious. The higher multicellular animals, or Metazoa, consist of a colony of cells which display different degrees of specialization for the performance of the different functions to which evolution assigned them. Their degree of specialization is of course measured by their degree of departure from the simple, primitive nucleated cells from which they have been derived by descent. Perhaps the most specialized are those which have become the threads of the connective and elastic tissues, and those of the tendons. Those of the modified epithelial tissues which cover the integument of the body, with its appendages, as scales, nails, horns, and hairs, are also highly modified. Muscular tissue is a little less specialized. In none of these tissues do we find consciousness. It is not cer-

tain that sensation resides in any but the cells of the nervous system, and if those of the peripheral parts of the system possess it, they do not retain it if they lose their connection with the central system. Now the cells of this system are the least modified of all those that constitute the soma of the metazoon, and thus they resemble most nearly the simple beings which constitute the lowest forms of the Protozoa. If they are capable of sensation in the one case they are likely to do so in the other. It appears that the conscious cell is the primitive cell, and the unconscious cell is the modified or specialized cell. And this conclusion coincides with what we know of the relation of consciousness to function in the animals in which we can examine the history of both. Specialization of structure means specialization of function; and specialization of function means accomplished education. Completed education, as we have already seen, means unconsciousness, while consciousness is necessary to the beginnings of education, and to its successive steps up to completion. We are then led by the analogies of the education of tissues, as well as by their structure, to the belief in the presence of consciousness in the Protozoa. The demonstration of a sense analogous to sight in the Infusoria by Klebs and Pouchet, and in the Cœlenterata by Romanes and Eimer, renders it unnecessary to pursue the argument further into the next higher type of the animal kingdom.

Were the above reasons insufficient to lead us to our conclusion, a consideration of the movements of the Protozoa would do so. All authorities agree that some of the actions of the Infusoria are in no sense automatic, but display a design as appropriate to the occasion as do those of the highest animals. The movements of the body of these animals are definitely directed towards their food or prey, and towards their opposite sex, and as definitely directed away from dangerous enemies. The movements of particular parts of their bodies, as of their cilia and flagella, have definitely designed movements for special occasions. Some of the movements of the Amœbæ have been, probably correctly, regarded as having a purely physical origin, due to the mobility of their protoplasm, and their contractility; but others, such as the projection of pseudopodia towards food with which they are not

already in contact, cannot be explained in this way. Their selection of food and rejection of injurious substances, though not always performed without errors, indicates the presence of sensation. The building of external protecting envelopes composed of grains of solid substances by the Difflugiæ cannot be explained by the action of physical causes only; and the arrangement of pieces in regular order as an envelope by the Rotifer Melicerta indicates still more definitely the presence of consciousness in some form.

We cannot discover any such design in the movements of phagocytes and of spermatozoöids. The former engulf leucocytes and other bodies with which they come in contact, very possibly for physical reasons, but do not pursue them, nor indicate their perception of their presence in any way. The movements of spermatozoöids appear to be without direction other than that given them by the vibrations of their flagella, by the cilia of the canals which they traverse, and perhaps by some physical attraction not at present explainable. The attraction of the spermatozoöids of certain ferns and hepaticæ by solutions of malic acid and cane sugar have been regarded as chemical, but this can scarcely be the correct explanation. A physical relation is much more probable, if sensation is excluded.

The presence of predication cannot be inferred from the existence of consciousness in the lowest forms of life. An action is designed if it is a response to a present stimulus or sensation, even if there be no memory, and the act is a new one every time the stimulus is applied. It is evident, however, that education commences low in the scale, since some of the acts of the Infusoria indicate an adaptation of means to ends which cannot be supposed to be possible to a totally new experience. The discharge of the weapon-like cilia of the Dinidium at its prey would indicate that the animal knew the effect of the act from past experience, and anticipated that food would be secured in this way from its success in previous performances of the kind. Memory is, so far as we know, a general attribute of living protoplasm, and it is probable that it enters into the psychic acts of very low organisms. It may be in the beginning unconscious

memory,—merely the habit of identical response to identical stimuli, on the principle that energy in organic substances most easily traverses accustomed channels. But it is not easy to believe in a stimulus which is not consciously felt producing anything but an undesigned, indefinite movement; and memory, conscious or unconscious, could only repeat it. A movement directly related to the satisfaction of sensation could only originate in a sensation, and the unconscious memory would repeat it blindly on the occasion of the experience of an identical stimulus. So soon as conscious memory should appear, the possibility of more exact adaptation or design in an act would appear. Variations in the act appropriate to variations in the stimulus would become possible. We may suspect conscious memory in the exact ratio of the appearance of predication under slightly varied circumstances, when narrower resemblances and differences are evidently to be taken into account. In such cases comparisons of memories are necessary, and rudimentary classification begins.

Mr. Romanes, in his work, "Mental Evolution in Animals," gives the following as his "criterion of mind": "The criterion of mind, ejectively considered, consists in the exhibition of Choice, and the evidence of Choice we found to consist in the performance of adaptive action suited to meet circumstances which have not been of such frequent or invariable occurrence in the life-history of the race as to have been specially and antecedently provided for in the individual by the inherited structure of its nervous system." This is an excellent definition of mind which has reached the stage of predication. But for purposes of classification, I should include all the phenomena of consciousness in the domain of mind, as distinguished from that of no-mind or physical energy. Such is the custom of metaphysical writers, who include perception within the range of their science, as it seems to me properly. The simple sensations should be included within the realm of mind. Here also should be included the "subconscious" state, with which we are all more or less familiar. Thus an impression may be made on the mind while its principal consciousness is otherwise occupied, and this impression may lead to attention, which is followed by a more distinct impression, if the cause of it

is still present. And the subconscious impression may be recorded as a memory, but not so thoroughly as if the impression were more distinct. Thus, the fleeting pictures of dreams are feebly impressed and but slightly recorded as memories. Such subconscious states may well be frequent in animals, especially in those where the external conditions are uniform, and new stimuli infrequent, for longer or shorter periods. But vigorous stimuli, as appeals to the general or special senses, quickly rouse animals, as well as man, to intense degrees of consciousness.

Since the sense-perceptions are well known to exist in animals, I will not give further special attention to them. Memory need not be especially considered, as its existence is necessary to the activity of all mental processes. I therefore proceed to the illustrations of the affections and the reason as observable in animals below man. Equally necessary to the existence of both affection and reason is association. Association of pleasures or pains with given objects forms the basis of liking and disliking, and of designed or rational action with regard to them. The more especial characters displayed by association will be especially treated of under the head of the reason or intelligence.

2. THE AFFECTIONS.

Preferences for especial articles of food and drink are known to characterize animals, not only on the ground of physiological necessity, but for reasons less easily explained. Reasoning from our own experience, we may ascribe the latter class of preferences to the gustatory sense, which is stimulated by certain flavors, and which rejects others. The gustatory sense, together with its near ally, the olfactory, is generally a safe guide to the function of assimilation, but not always, and in mankind it is often quite whimsical. In general, all of the "appetites" are common to man and the other animals.

More pronounced likes and dislikes are common among animals, and these are to be generally attributed to the action of association of memories, pleasant and unpleasant. The smell and sight of blood create the greatest excitement among animals of the ox kind, so much so that even the color red stimulates the

antagonistic passions of the bull. The action of association is here evident. The dog associates the gun with the chase, and as soon as he sees his master take it up his passion for hunting his food is aroused, and his joy is demonstrative. Sudden movements near a hive of bees or a nest of hornets (*Vespa maculata*) are unsafe, as these insects evidently anticipate danger, and proceed at once to attack the supposed enemy. The emotion of fear of all degrees is well-nigh universal in the animal kingdom, as few species, from the Protozoa upwards, do not endeavor to escape a present or anticipated danger. In no animal is fear more strongly developed than in some of the monkeys. A *Cebus capucinus* and a *C. apella* in my possession sometimes escaped from their cage, and could only be caught after a vigorous chase. In pursuit they became so terrified as to fall in an unconscious condition on the floor. They were cold when picked up, but they soon recovered. I have never known any other species of animal to faint from fright.

The social affections are seen low in the scale, and the maternal instinct is the first to present itself to our notice in the order of development. The endeavors of females to protect their eggs may be due to the fact that they regard them as part of their own bodies, as in the case of spiders, but an altruistic feeling (in the selfish sense of the word) must be admitted to be present in the exercise of the care of the young. This affection appears sporadically among invertebrate animals, but is very general among Vertebrata, becoming a master passion in many of them. The attraction of the female for the male is seen in low forms of life, where it is transient, and often little or not at all reciprocated on the part of the female, so that contrivances for the compulsory fertilization of the latter by the former are numerous. In the higher forms the affection is more or less reciprocal, and in the highest forms a distinct conjugal affection is developed. Whether this exists in forms below the birds is uncertain. Rattlesnakes associate in pairs, as do also sword-fishes. An account is given by Brown Goode of a furious and successful assault on a boat made by a sword-fish whose mate had been harpooned and captured by the boat's crew. Mutual affection between two individ-

uals of the same or of different species, without regard to sex, is not uncommon among birds and in mammals, and is probably an outgrowth of the maternal and sex instincts. The affection of many of the Mammalia for their human masters is well known, although this sentiment differs greatly in degree in individuals o fthe same species, as, for instance, in the dog.

Shame is evidently experienced by some of the Mammalia, especially by monkeys and by dogs. This affection is an anticipation of the ethical sense, a quality which will be considered under the head of the intelligence, further on.

Jealousy is strongly developed in Mammalia, especially among dogs. It is quite as obvious among these animals as among human beings. An illustration of jealousy on the part of a chimpanzee used frequently to amuse the visitors to the Zoological Garden of Philadelphia. It was the custom of the keeper to feed a pair of these animals together with bread and milk, using a spoon. One sat on each side of him with an arm placed about his waist, and the keeper fed them alternately. At times he would intentionally neglect one or the other of them. As this continued the neglected animal showed his displeasure by pouting the lips, and finally he would rush from the side of the keeper, and throwing himself on his back would give way to a burst of jealous rage. He kicked his feet, threw straw into the air, and screamed vigorously, the whole proceeding resembling what one sometimes sees in a spoiled child. On the offer of renewed attention from the keeper, the chimpanzee was pacified, and took his original position with great satisfaction.

Another and older chimpanzee confined in the same garden became paralyzed in the posterior limbs. Two lemurs (*L. catta.*) were given to it for company. Their playful activity was at times a source of irritation to the chimpanzee. Her grimaces and cries of rage at these harmless creatures were laughable, and her impotent attempts to dislodge them from their hold above her, by shaking the wood-work on which they rested, was an exhibition of passion which was quite ridiculous.

Admiration for brilliant or impressive colors or forms is evidently experienced by the vertebrate animals. It is probably present

much lower in the scale. Protozoa collect about the light, and show a decided preference for certain colors. This attraction is of course of a low type of mentality, expressive of a simple form of consciousness, but it cannot certainly be ascribed to chemical or physical causes. In any case it acts through sensation. Insects are believed to be attracted by showy flowers. Among vertebrates, birds show the most evident admiration for bright colors. The bower-birds (Ptilonorhynchus, Chlamydera, etc.) collect brightly-colored objects and arrange them about their play-houses and nests. The attention which the females of many birds which have brilliantly-colored males give to their exhibitions of themselves by the latter, is well known. The attractions thus offered to the females give opportunity for the sexual selection of Darwin and Wallace, which has no doubt had much to do with the preservation of beauty and other admirable variations of animal type.

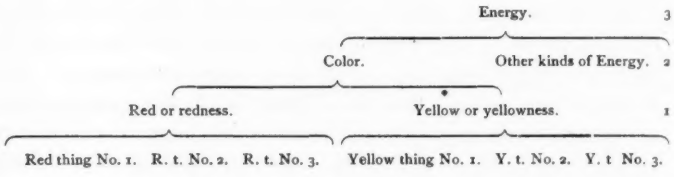
A most evident illustration of admiration for brilliant color and extraordinary form was furnished by the monkeys in the Zoological Garden of Cincinnati. A large adult male mandrill (*Cynocephalus mormon*) was confined in a large cage with numerous smaller species of the old world monkeys. The mandrill had reached the age when the crest, beard, and bright blue, vermilion, and purple colors of the skin were in perfection. The smaller monkeys displayed the most respectful admiration for the huge beast, who stood or sat in the middle of the cage and received their adulation. The smaller species gazed upon the wonderful harlequin and moved about him in a deferential manner. His majesty occasionally seized one of them by the tail or the hind leg, and after submitting him to an examination, flung him from him with an expression of contempt. This did not seem to check their devotions, however, and they continued moving about him in circles and gazing at him.

3. RATIOCINATION.

In this section I will endeavor to state the character of the mentality of animals with respect to the faculty of reason, and to compare the latter with the corresponding department of the mind of man. Considerable light as to the essential nature of

reason must be gained from this research. It is well known that three distinct views may be taken of the source of this important faculty. These positions are the two extremes of realism and idealism, and the intermediate one maintained by Kant. According to Locke and the experiential school reason is a product of sense-perception or experience, and is *a posteriori*. According to Berkeley, Hegel, and the idealists, this faculty is *a priori* or intuitive, and creates the material world in its own likeness. Of this likeness sense-perception is the expression. According to Kant, sense-perception of a real universe is the material of thought, but it can only be comprehended through the necessary logical form of thought, which therefore presents a real material world to us in this form, but not as it is in itself. The relation which the evolution of mind has to this question will be considered in another essay.

Conception.—While perception and emotion are very generally granted to animals, it has been often denied that they are capable of conception or generalization. The formation of a concept is a result of classification, and the general idea which is a concept, is not an object, but a mental picture of several objects or parts of objects in combination. Concepts are of various grades of generality, as may be exhibited in the following table:


Energy. 3
Color. Other kinds of Energy. 2
Red or redness. Yellow or yellowness. 1
Red thing No. 1. R. t. No. 2. R. t. No. 3. Yellow thing No. 1. Y. t. No. 2. Y. t No. 3.

In the above analysis three grades of generalization are represented; all derived from the individual objects enumerated in the bottom line. Each one requires successively greater mental grasp, and in the case of the highest generalization, the especial knowledge attained only by the scientific man. But the first or lowest grade of generalization is clearly within the scope of the animal mind. Thus the bull attacks a red object without ascertaining especially whether it is blood or a red cloth; he sees only

the redness. So with the water-fowl seeking water. He alights on a surface of water when and where convenient, without discrimination as to the particular piece of water. The crow and other animals avoid man in general, without discrimination as the particular man, in the absence of special instruction. That this is an exact generalization is shown by the usual indifference of such birds, etc., to cattle and other, to them, innocuous animals. In fact, it is quite easy to show, as Mr. Romanes has done, that a low grade of generalization is common to most animals, and that it is quite as natural to them as the particularization of individuals. That they are at the same time not incapable of particularization is easily seen. The water-bird ultimately seeks its accustomed locality for breeding. The bird or mammal learns to know its master, and to distinguish him from other persons by their confidence and friendship.

It is claimed by Professor Max Müller and other persons, that conception is impossible without language; *i.e.*, that it is impossible to form concepts without words to represent them as symbols. Now this is clearly not the case. The naturalist conceives his genera, orders, classes, etc., before he names them. One can readily conceive of redness, yellowness, etc., without naming them, and it is perfectly evident that many animals below man do the same.[1] It is only a question of the mental power of the individual as to how wide a generalization he can thus conceive.[2] I see no reason why this power may not extend to the highest possible grade of generalization in the most able of human minds. Nevertheless to most persons symbols or names are necessary to the accomplishment of the higher concepts. Names constitute an invaluable aid in the construction of rational edifices. They are well compared to a scaffolding to a building, and it is quite possible, as Romanes remarks, for a grade of conception thus attained to need the aid of words

[1] This has been well shown by Mr. Romanes in his Mental Evolution of Man, Origin of Human Faculty, Chap. III.

[2] For this reason I do not see the necessity for the subtraction of the lowest grade of concepts under the name of "recepts," as has been proposed by Mr. Romanes, *l.c.* Chap. II. Other grades of generalization might be as readily separated under distinct names.

no longer, and to become automatic, and a part of the mental furniture. That the use of words has been the cause of an acceleration of rational development in man there can be no doubt; but the mentality of the lower animals contradicts the supposition that it was entirely essential.

Many of the mammalia understand human language. They understand the meaning of words apart from tone and gesture. This can be most frequently seen in dogs, some of whom become remarkably expert in carrying out orders from their masters. Examples of this kind are familiar to many persons. Now the giving of orders involves the use of verbs. Verbs do not represent objects, nor do they represent even single acts, but they express a class of single acts. In the comprehension of a verb, a dog performs an act of simple generalization, distinctly above the mere recognition of an object by a name.

Induction.—Most evident is the existence in animals of the faculty of induction, which involves a generalization; *i.e.*, the drawing of a single general inference from a number of instances. While pure conception expresses cognition only, induction infers action on the part of its objects. From such and such premises, such and such events will follow, either as coincidence or as effect.

I now give some illustrations of experiential inference, and deductive or practical application, among the lower animals.

A great many animals adopt methods of concealment to escape observation, both of enemies and of the prey they seek. Certain species of crabs attach to their carapace pieces of algæ, which then vegetate and cover the animal with a growth which conceals it. Others carry a stone above the posterior part of the carapace, which serves as a basis of attachment for foreign organic growths which conceal them. Still others permit the growth of sponges and actiniæ on various portions of their surface, which sometimes cover them completely from view. Among birds peculiar attitudes are adopted, which serve as an effective concealment; such are those of some of the herons, which stand bolt upright in growths of reeds and thickets, so as not to be distinguished from the surrounding stems and trunks. So the

Gallinæ and some of the snipe family squat on ground, which they resemble in color, until danger has passed. An ingenious device is employed by certain green snakes of North America (*Liopeltis vernalis*). They burrow under the earth, and then permit the head and a few inches of the body to emerge. This portion of the body is held rigidly vertical, and is not distinguishable on a cursory view from the shoots and stems of green vegetation which surround it.

Fear sometimes stimulates an animal with the desire to inspire fear in return. I once observed this in the conduct of a *Heterodon platyrhinus* (hog-nose adder), which was kept in a cage with a water-snake (*Natrix sipedon*) and a copperhead (*Ancistrodon contortrix*). Both of the harmless species were evidently greatly frightened on the introduction of the copperhead into the cage. The water-snake sought the lowest spot in the sand on the bottom of the cage, and coiling up kept close to the ground, not even raising his head. The Heterodon, on the contrary, inflated his long lung, swelling the greater part of his body into the form of a cylindrical bladder. He at the same time extended the anterior ribs, so that this part of the body resembled the thin blade of a paper-cutter. He then plunged his nose into the sand, and covered the top of his head with as large a pile of that substance as it would carry. In this disfigured condition he paraded slowly about the cage in front of the copperhead. The latter moved but little, and showed no disposition to provoke a quarrel with its singular companion. The *Heterodon platyrhinus*, when disturbed by man, throws itself into vigorous contortions, spreads the anterior ribs, and opens the mouth widely, after the manner of a venomous snake. The habit of erecting, under the stimulus of fear, the feathers and hair in order to increase the apparent size of the body, and so inspire fear, is common among birds and mammalia. The artificial ferocity of many monkeys, while under the influence of the very opposite emotion, *i.e.*, fear, is often very amusing. Monkeys generally look away from a person whom they wish to attack, so as to throw the latter most completely off his guard.

(*To be continued.*)

THE HARVEST SPIDERS OF NORTH AMERICA.[1]

BY CLARENCE M. WEED.

THE harvest spiders, harvest men, daddy-long-legs, or grab-for-gray-bears, as they are variously known in different parts of the United States, form a distinct family—Phalangidæ—of Arachnida, which has as yet received comparatively little attention at the hands of American entomologists. In zoological classification the family belongs to the suborder Opileonea, of the order Arthrogastra, and sub-class Arachnida.

The Phalangidæ are at once distinguished from other Arachnids by the united cephalothorax and abdomen, the long legs with multiarticulate tarsi, the well-developed palpi and tarsal claws, the five or six ventral segments, the first of which is abruptly contracted in front and prolonged forward between the coxæ, and the two eyes close together upon an eminence at the middle of the dorsum of the cephalothorax.

Our knowledge of American harvest spiders dates from the time of Thomas Say, who, in 1821, described four species under the genus Phalangium. Half a century later Dr. H. C. Wood redescribed Say's species, and added eleven others to the list. Since then five additional species have been described by the present writer, who has also referred the others to their modern genera.

During a recent study of the Phalangidæ of the United States, as represented by collections made, largely through the kindness of entomological friends, in thirteen widely separated States, I have been able to recognize all of the described species, except two, viz., *P. grande* Say, occurring in the Southern States, and *P. exilipes* Wood, from the California coast. At least four of our forms fall into the subfamily Schlerosomatinæ, which has not before been recognized in our fauna. One species, the *P. nigrum* of Say, apparently belongs to the genus Astrobunus Thorell, while two of Wood's species, *bicolor* and *favosum*, will apparently require the erection of new genera to contain them, although at

[1] Read before Section F., A. A. A. S., at Indianapolis meeting.

present provisionally retained under Astrobunus, where also Say's *grande* may conveniently remain until the discovery of specimens enables it to be properly placed.

At least four genera of the subfamily Phalangiinæ occur in our fauna. Three of these have before been characterized, while the fourth is new. The first, and in number of species by far the largest, genus is Liobunum of C. Koch, which is characterized by having the palpal claw denticulate, and the maxillary lobes of the second pair of legs clavate in shape, enlarging from the base to the apex. Ten of our species, one of which is yet undescribed, belong to this genus, and two others—*exilipes* and *calcar*—are provisionally retained in it.

Closely allied to Liobunum, but easily distinguished from it, is a genus as yet uncharacterized, for which the name Forbesium is proposed, in honor of Professor S. A. Forbes, Director of the Illinois State Laboratory of Natural History. Its characters are as follows:

Teguments very soft. Anterior and lateral borders of the cephalothorax smooth. Eye-eminence distinct, entirely smooth, not canaliculate; separated from the anterior border by a space equal to its diameter. Lateral pores large, oval, marginal, with a deep oblique sinus behind each. Entire dorsal surface smooth, without tubercles or spines. Anal piece large, transversely oval. Mandibles short, similar in the two sexes, the first joint provided on the under side, near the base, with a distinct tooth. Palpi slender, rather long, the patella having a well-developed conical tubercle on its inner distal angle; claw denticulate. Maxillary lobes of second legs in the form of elongate triangles, as shown at Fig. 3, Plate XXX. Legs rather stout, and of only moderate length.

Members of this genus are at once distinguished from those of Liobunum by the elongated triangular maxillary lobes of the second pair of feet, the conical projection on the palpal patella, and the perfectly smooth uncanaliculate eye-eminence. In Simon's synopsis of European genera it comes between Liobunum and Prosalpia, but it also differs materially from the latter.

Two species of Forbesium occur in our fauna, the first, *F. formosum*, having been described many years ago by Dr. H. C. Wood, and the second, which may be called *F. hyemale*, being undescribed. The former is a distinctively northern species, ranging from New York to Colorado, while the latter is evidently its southern representative. Both are exceptional in that they hibernate as adults rather than in the egg state.

The undescribed species is represented at Plate XXXI., Fig. 1, showing its natural size, and Fig. 2 its structural details magnified: *a*, representing a dorsal view of the body; *b*, a side view of the eye-eminence; *c*, a front view of the same; *d*, a side view of the palpus; and *e* a similar view of the palpal claw. It may be described as follows:

Forbesium hyemale.—Female.—Pl. XXXI., Fig. 1, 2. Length, 7 mm.; width, 4 mm. Legs: I., 32 mm.; II., 60 mm.; III., 31 mm.; IV., 45 mm. Body soft. Dorsum smooth; mottled cinnamon-brown. A distinct dark central marking begins at eye-eminence, and runs two-thirds of the way to the posterior extremity; it contracts near the anterior border of the abdomen, then expands in an even curve, and again contracts in a similar way. There is a deep oblique sinus just back of each lateral pore of cephalothorax. On the abdomen are scattered dark spots, arranged in irregular transverse series. Eye-eminence perfectly smooth; black about eyes with a light-brown longitudinal central marking; slightly longer than high; not at all canaliculate. Mandibles light gray, with tips blackish; sparsely provided with short black hairs. Palpi slender; mottled grayish-brown; all the joints provided with short, black, stiff, spinous hairs. Patella arched; its inner lateral distal angle produced into a pronounced conical tubercle. Tarsal claw distinctly pectinate. Ventral surface light gray. Legs long, rather stout; coxæ light gray, remaining joints mottled cinnamon-brown.

Described from three specimens taken at Auburn, Alabama, by Professor George F. Atkinson.

Plate XXX. represents *Forbesium formosum*, the mature female being shown natural size at Fig. 1, structural details magnified at Fig 2, and the maxillary lobes of the second legs at Fig. 3. Both plates are from drawings by Miss Freda Detmers.

The genus Phalangium as at present restricted contains but two of our forms, *cinereum* Wood and *longipalpis* Weed. *P. cinereum* is one of our commonest species, and occurs from New York to

PLATE XXX.

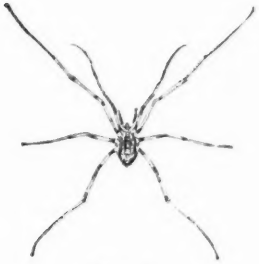


FIG. 1.

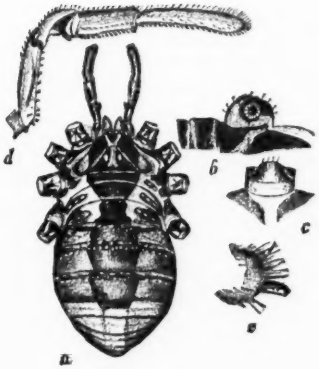


FIG. 2.

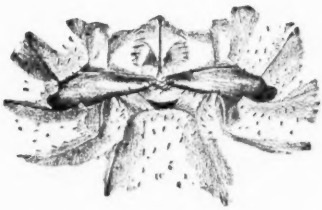


FIG. 3.

Forbesium formosum Wood.

PLATE XXXI.

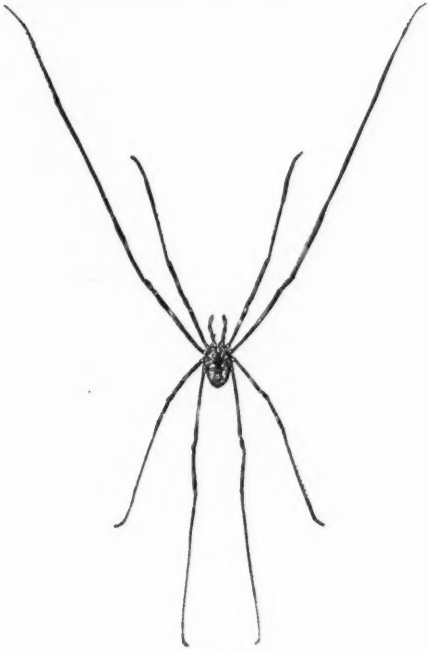


FIG. 2.

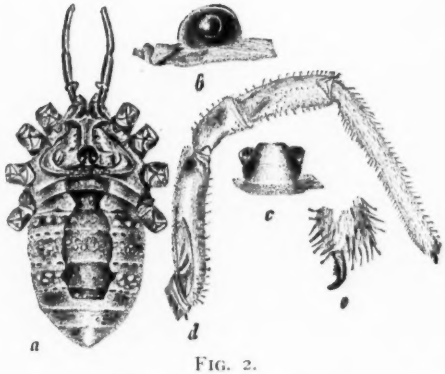


FIG. 2.

Forbesium hyemale Weed.

Nebraska, though apparently not extending into the Southern States. *P. longipalpis* is a southern form,—having been received as yet only from Arkansas,—which is remarkable for the extremely long palpi and abnormal cheliceræ of the male, while in the female the palpi are of the usual length and the cheliceræ normal in form.

Two species of the genus Oligolophus occur in our fauna. The first, *O. pictus* Wood, has been taken in Massachusetts, New York, Illinois, and Ohio. It is quite rare, though not so much so as the other, *O. ohioensis* Weed, which has as yet been found only in Illinois and Ohio.

Summarizing these statements, we find that, so far as at present known, the phalangid fauna of North America includes but twenty-two species, belonging to two subfamilies. The first subfamily, Sclerosomatinæ, claims four forms, one of which belongs to Astrobunus, while the generic position of the other three is at present in doubt. The subfamily Phalangiinæ includes four genera, viz., Liobunum with twelve species; Forbesium with two species; Phalangium with two species; and Oligolophus with two species.

It must be confessed that, for the area represented, this is a very small showing, and undoubtedly the list will be greatly lengthened when the fauna of the mountainous regions and the more remote sections of the country is better known. France has a list of fifty-nine of this family, and the phalangid fauna of other European countries is proportionately large.

List of North American Species.

Family *PHALANGIIDÆ.*

Subfamily SCLEROSOMATINÆ,

Genus Astrobunus Thorell.

1. *A. nigrum* Say.
2. *A.* (?) *bicolor* Wood.
3. *A.* (?) *favosum* Wood.
4. *A.* (?) *grande* Say.

Subfamily PHALANGIINÆ.

Genus LIOBUNUM Koch.

5. *L. dorsatum* Say.
6. *L. elegans* Weed.
7. *L. longipes* Weed.
8. *L. maculosum* Wood.
9. *L. nigripalpis* Wood.
10. *L. politus* Weed.
11. *L. similis* Weed (M S.).
12. *L. ventricosum* Wood.
13. *L. verrucosum* Wood.
14. *L. vittatum* Say.
15. *L.* (?) *exilipes* Wood.
16. *L.* (?) *calcar* Wood.

Genus FORBESIUM Weed.

17. *F. hyemale* Weed.
18. *F. formosum* Wood.

Genus PHALANGIUM Linn.

19. *P. cinereum* Wood.
20. *P. longipalpis* Weed.

Genus OLIGOLOPHUS Koch.

21. *O. ohioensis* Weed.
22. *O. pictus* Wood.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

WHILE the pursuit of pure science deals with the abstract, since nature has a physical basis the scientific man cannot neglect the practical. Like other men he must live, and he must have a career. In order to live he must have a reputation, or in other words he must, like other men, advertise his wares. Such is the practice of the worker in science, and happily such practice coincides with his direct line of work, which is the development of human knowledge. His pursuit advertises itself to the intelligent, so that the investigator need not go out of his way to become known if his work is good. And his reputation means a position and support for himself and his family.

It is not uncommon, however, to hear very exalted sentiments uttered by the enthusiastic devotee, to the effect that he cares nothing for the ordinary indications by which he may be known. He particularly disclaims the vulgar desire to give names, when it is fully within his right to do so, and he looks down with contempt on the man who thus affixes a trade-mark to the goods which he has himself produced. Now this is nothing but a mild form of hypocrisy, pleasing to him who entertains it and to the groundlings who know nothing of life, but it deceives no others. Let another step in and try to set up his shop in the "preserves" of these gentlemen, or let him try to attach his label to what he may discover therein, and human nature displays itself in vigorous forms. They are not so indifferent as they pretend to be.

We sometimes hear suggestions that the scientific field shall be divided. A shall do this, B that, and so on. Such propositions are most likely to emanate from some person who fears the industry or the ability of some one else, and desires to preëmpt a claim from which "depredators" shall be excluded. This also is human nature, but it is not the right kind. The defenders of such methods, however, assure us that it is in the true interest of science!

These remarks are *apropos* of a recommendation contained in the address before the Geological Section of the American Association for the Advancement of Science, of 1890, by its chairman, Prof. Jno. C. Branner, who is director of the Geological Survey of Arkansas. He recommends that the State Geological Surveys confine themselves to economical geological work, and leave the solution of all scientific problems to the United States Geological Survey. Perhaps Professor Branner intends to do this in the case of the survey which he directs, but if he does so we should consider him derelict in his duty to the people who have appointed him. We doubt, however, whether he will or can do so. As to other geological surveys, his proposition will be apt to provoke a smile. The scientific geologist, wherever located and however situated, will not probably confine himself to economic questions. Nor will the literature of geology be diminished as Prof. Branner professes to desire. If scientific geology is to be restricted

to the U. S. Geological Survey, and economic geology to the State Surveys, where do the Universities come in? and where private investigators working at their own expense?

It has been said that most men, if they had the opportunity, would be despots, and they would at the present time, as they have often in the past, plead some public good as their excuse. But in science most especially despotism is impossible. The investigator has the "inalienable right" to "life, liberty, and the pursuit of happiness" in the direction of scientific researches, and no man is competent to tell him what he shall do and what he shall not do. His *raison d'etre* is the quality of the work he does, and if his work is bad, it simply sinks out of sight. What good he does will be credited to him in the court of approval of the world of science, where everything stands on its merits, and local ambitions and political tactics are unknown.—C.

—WHILE there were a goodly number of entomological papers read at the recent Indianapolis meeting of the Society for the Promotion of Agricultural Science and the Entomological Club of the A. A. A. S., there was a notable scarcity of such papers before the Biological Section of the Association. This paucity was a subject of remark not only among entomologists, but workers in other lines as well. It is very desirable that in future years students of insect life furnish more papers of general biological interest, following in this respect the excellent example set by the botanists. While there is just now an urgent demand for the solution of many purely economic problems in entomology, and official workers are wisely devoting much of their time to these, they can scarcely afford to neglect entirely the biological side of their subject. Not only is there great need of the elucidation of insect life-histories, many of which are complex and difficult to determine, but there are hundreds of points where entomology touches the problems of general biology, and is able to aid greatly in their solution. No better illustration of this can be cited than the admirable researches of Professor and Mrs. Peckham upon the senses of wasps and sexual selection and mimicry in the spiders of the family Attidæ. Papers upon the classi-

fication and distribution of insects seem also of late to have become unfashionable at the association meetings, without sufficient reason. In the present craze for purely practical entomology it should be remembered that there is very little entomology that is not in some sense economic, and that if entomologists wish to attract to their ranks a desirable class of amateur students, they must show that in the world of insects there are other problems than those of spraying with the arsenites or fighting the codling moth.—W.

—THE electric execution law of New York State should be repealed pending the development of our knowledge on the subject. The course of an electric current in or on such a bad conductor as the human body is difficult to foresee, and in the case of Kemmler it seems to have disappointed the expectations of the designers of the apparatus. The current did not traverse the spinal cord as was intended, but followed the dorsal muscles, which were, according to the reports, completely roasted. What is then to prevent its taking a superficial direction on the head as well? The frequent statements which are made of men receiving shocks of higher power than that used in the execution of Kemmler confirms the belief that the direction of the current is an uncertain quantity in the problem. So long as this uncertainty remains, so long will electrical execution be a trifling with the subject, which is inexcusable. In the present state of our knowledge of the subject the law is a disgrace to the statute-book of the State of New York. Execution by hanging is not thought to be a painful manner of death, although the guillotine is probably less so.

We expect to have some comment on the subject, in a future number of the NATURALIST, by a well-known expert, who was present at the execution of Kemmler.

RECENT BOOKS AND PAMPHLETS.

ALLEN, H.—The Distribution of the Color-Marks of the Mammalia. Ext. Proc. Phila. Acad. Nat. Sci., Feb., 1888. From the author.

——Description of Two New Species of Bats, *Nyctinomus euryops* and *N. orthotis*. Ext. Proc. U. S. Nat. Mus., Vol. XII., pp. 635–640. From the Smithsonian Institution.

ALLEN, J. A.—Notes on a Collection of Mammals from Southern Mexico, with Descriptions of New Species of the Genera Sciurus, Tamias, and Sigmodon. Ext. Bull. Am. Mus. Nat. Hist., Vol. II., No. 3. From the author.

——On North American Ground Squirrels. Ext. Bull. Am. Mus. Nat. Hist. From the author.

Annual Report of the Canadian Institute, 1888–9.

Annales de la Société Entomologique de Belgique. Tome Trente Deuxième.

Annales de la Société Belge de Microscopie. Tome XII.

Annalen des K. K. Naturhistorischen Hofmuseums. Redigirt von Franz Ritter Von Hauer.

BECKER, G. F.—An Elementary Proof of the Earth's Rigidity. Reprint from the *Am. Jour. Sci.*, Vol. XXXIX., May, 1890.

BLACKMAR, F. W.—The History of Federal and State Aid to Higher Education in the United States. From the Bureau of Education.

BLYTT, A.—Additional Note to the Probable Cause of the Displacement of Beach-Lines. From the author.

BOETTGER, O.—Ueber die Leistungen in der Herpetologie Während des Jahres, 1886.

——Verzeichnis der von Hernn Stäatsrath O. Retowski auf seiner Reise von Konstantinopel nach Batum Gesammelten Reptilien und Batrachier. Sonderabdruck aus Bericht über die Senckenbergische Naturforschende Gesellschaft in Frankfort A. M., 1889. From the author.

BOLLMAN, C. H.—Notes on a Small Collection of Myriapods from the Bermuda Islands. Ext. Proc. Phila. Acad. Nat. Sci., 1889.

BONAPARTE, R.—Le Premier Etablissement des Néerlandais à Maurice.

——Le Golfe Huon. Note on the Lapps of Finmark. Le Fleuve Augusta. From the author.

BONAPARTE, C. J.—Civil Service Reform as a Moral Question. From the author.

BONNEY, T. G.—Notes on Two Traverses of the Crystalline Rocks of the Alps. Ext. *Quar. Jour. Geol. Sci.*, Feb., 1889. From the author.

BONWILL, W. G. A.—The Philosophy of Eating and Drinking from a Dental and Medical Standpoint. From the author.

BOULENGER, G. A.—A List of the Reptiles and Batrachians of Amoorland. Ext. *Ann. and Mag. Nat. Hist.*, Feb., 1890.

——Note on *Python curtus*. Ext. Proc. London Zool. Soc., Nov., 1889.

——On Some Specimens of Lizards in the Halle Zool. Mus.—Second Account of the Fishes Obtained by A. S. G. Jayakar, at Muscat, Arabia. Exts. Proc. London Zool. Soc., 1889. From the author.

BRAINARD, E., AND H. M. SEELEY.—The Calciferous Formations in the Champlain Valley. Ext. Bull. Geol. Soc. Am., Vol. I., pp. 501–516.

Bulletin of the U. S. Fish Commission, Vol. VII. From the Fish Commission.

Bulletin of the Washburn College Laboratory of Nat. Hist., Vol. II., No. 11.

Bulletin No. 4, Agri. Exp. Sta. of the Rhode Island State Agri. School.

BURMEISTER, H.—Bericht über Mastodon andium. Sitzungsb. K. Preuss. Akad. Wissenschaften, 1888.

CHAMBERLAIN, T. C.—Some Evidences Bearing on the Interval Between the Glacial Epochs. Ext. Bull. Geol. Soc. Am., Vol. I., pp. 469-480. From the author.

CHAUNCEY, H., DE.—Etude sur l'Origine des Basgares. Ext. du Bull. Soc. Geo., 1889. From the author.

CLARK, W. B.—On the Tertiary Deposits of the Cape Fear River Region. Ext. Bull. Geol. Soc. Am., Vol. I. From the author.

COOK, A. J.—Insecticides, Bulletin 58; Fowl Brood, Bulletin 61; The English Sparrow, Bulletin 62; Agricultural Station Michigan State Agricultural School. From the author.

CRAGIN, F. W.—Contributions to the Palæontology of the Plains. Bull. Washburn College Laboratory, Vol. II. From the author.

CROSBY, W. O.—Physical History of the Boston Basin. From the author.

DALL, W. H.—Preliminary Report on the Collection of Mollusca and Brachiopoda. Obtained in 1887-'88. Ext. Proc. U. S. Nat. Mus., Vol. XII. From the Smithsonian Institution.

——On Dynamic Influences of Evolution.

——On the Hinge of Pelecypods and its Development, with an Attempt toward a better Sub-division of the Group. Ext. *Am. Jour. of Sci.*, Vol. XXXVIII.

——A Preliminary Catalogue of the Shell-Bearing Marine Mollusks and Brachiopods of the S. E. Coast of the U. S. Bull. U. S. Nat. Mus. No. 37. From the author.

DILLER, J. S.—Sandstone Dykes. Bull. Geol. Soc. of America, Vol. I., pp. 411-442. From the author.

EDWARDS, H.—Bibliographical Catalogue of the Described Transformations of North American Lepidoptera. Bull. U. S. Nat. Mus. No. 35.

EYERMAN, J.—Bibliography of North American Vertebrate Paleontology for the Year 1889. Ext. from the *American Geologist*, April, 1890. From the author.

EIMER, C. H. T.—Organic Evolution. From MacMillan & Co.

HAECKEL, E.—Natürlichen Schopfungs-Geschichte.

——Report of the Deep-Sea Keratosa Collected by H. M. S. Challenger, 1873-'76. From the author.

HADDON, A. C.—On Two Species of Actiniæ from the Mergui Archipelago. Ext. *Journ. Linn. Soc.*, Vol. XXI.

HALSTED, B. D.—Some Fungus Diseases of the Cranberry. Bull. 64, New Jersey Agri. Coll. Exp. Station.

HANCOCK, J.—Description of a New Species of Datames. Read before Am. Philos Soc., April, 1887. From the author.

HENSHAW, S.—Bibliography to American Economic Entomology. From J. M. Rusk.

HOUGH, W.—Notes on Aboriginal Fire-Making. Ext. Proc. A. A. A. S., Vol. XXXVIII, 1889. From the author.

IRELAN, W.—Ninth Annual Report California Mining Bureau. From the author.

KIRSCH, P. H.—Notes on Fishes Obtained by Lieut. Carpenter in the Gila River. Ext. Proc. U. S. Nat. Mus., 1888. From the author.

KOEBELE, A.—Natural Enemies of the Fluted Scale. Bull. No. 21, U. S. Dept. Agri.

——Report of the Fluted Scale of the Orange, and its Natural Enemies in Australia, Bull. No. 21, U. S. Department of Agriculture. From J. M. Rusk.

FORBES, S. A.—Report on the Noxious and Beneficial Insects of the State of Illinois. 1887-'88.

FRAAS, E.—Die Labyrinthodonten der Schwabischen Trias. Separat-Abdruck aus Palaeontographica, XXXVI. Band. From the author.

RECENT LITERATURE.

Dall on Dynamic Influences in Evolution.[1]—In this interesting paper we find that Mr. Dall turns to mechanical influences of environment as an essential factor in evolution.

It is generally admitted, he says, that in natural selection we have a theory which accounts for the perpetuation of favorable, and the elimination, in the long run, of unfavorable variations in organic beings. It is equally admitted that the origin of variation is not accounted for by this theory. To round out our conception of the mode of evolution it is necessary that this deficiency should be supplied. It should also be supplemented by some conception of the mode by which variation is sustained in a given direction until it has reached a point of usefulness sufficiently marked to enable the selective process to operate.

He accepts the relation of the organism to its environment as the desired factor, and for this adopt the name of Dynamic Influences. He maintains that acquired characteristics are inherited. The organism suffers during its entire existence a continuous series of mechanical impacts, none the less real because invisible. Since individual organisms usually appear free to wander or remain quiescent, the idea that they are under constant stress does not ordinarily suggest itself, and to this fact he ascribes the slowness with which the dynamic element in evolution has received recognition. The characters developed in an organism in response to impacts are acquired, but that which is transmitted is a facility of response in the same line. This, under favorable conditions and a series of generations subjected to similar impacts, may promote and establish the physiological habit, which is the directive influence towards the development of the characters in question.

The dynamics of environment vary within comparatively narrow limits, when consistent with organic existence. On the other hand, owing to the narrowness of the limits, the dynamic variations to which organic forms are subjected become relatively more important. It is probable that no two organisms have ever been subjected to exactly the same dynamic influences during their development. Differences of impact necessarily imply differences of response, hence variation is inevitable. The origin of variation, therefore, presents no difficulties.

[1] Read before the Biological Society of Washington, March 8, 1890, by Wm. H. Dall.

The question is, How are the small necessary and admitted differences stimulated to develop into the obvious differences recognized by systematic biologists? To this he answers that the reactions of the organism against the physical forces and mechanical properties of its environment are abundantly sufficient, if we are granted a simple organism, with a tendency to grow, time for the operation of forces, and the principle of the survival of the fittest.

It is often assumed that the possibility of variation is equal in every direction. A consideration of the dynamic conditions of life shows that this is not the case. Under conditions which would permit it, resulting organic forms would be sub-spherical, and would have to pass their entire existence in constant rotation. The moment one of them came to rest, it would be subjected to unequal stresses. Light, gravity, nutrition, etc., would be unequally distributed, forcing an unequal growth and specialization of regions. Inequality established, locomotion, with attendant friction and resistance, would confirm the inequality. Organic matter, as such, is in no sense released from the servitude of matter to the operation of physical forces.

Mr. Dall divides the operation of biologic selection into two categories: 1st, That in which fitness and unfitness are determined by the perfection in adjustment of the individual to the mechanics of the environment; 2d, That in which intelligence becomes a factor. The latter includes sexual selection, mimicry, protective coloration, etc. It is not necessary that the organism which is modified should possess even consciousness; but one of the two parties to the modification must possess intelligence of a certain grade. It is probable that influences of the second category operate more rapidly and produce greater diversity in development than could have been expected from the working of purely physical forces.

If the dynamic evolutionist brings forward an hypothesis which explains the facts of nature without violence to sound reasoning, that hypothesis is entitled to respect and consideration until some better one is proposed, or until some vitiating error is detected in it. For the dynamic hypothesis only those characters can be considered which arise from permanent physiological reactions due to the impact of external forces. Mutilations rarely fall into this category, and are essentially sporadic. A pathologic incident may affect the progeny, but only in trifling numbers, and it is of no importance to the dynamic hypothesis whether it can be proven or not. The forces invoked by dynamic hypothesis, on the other hand, affect every individual of a race and every generation as long as the environment continues unchanged.

It seems to the writer that Mr. Dall has not given the full value to pathologic cases. These may result from unfavorable surroundings; or at the close of the natural life of a species or group, pathologic changes may be taken on, as clearly shown by Prof. Hyatt in fossil Cephalopods. In these cases, all the individuals of a race and successive generations in a given locality or geological horizon may be induced to take on features of a pathologic character, and form a degradational series of individuals, species, or genera.

In studies of the development of the hinge of Pelecypods, and the columellar plaits of Voluta, Mitra, and other Gastropods, Mr. Dall gives concrete examples of dynamical genesis. These appeal strongly in in favor of this hypothesis, on account of the simplicity of the problem as he presents it, and the complete way in which the facts illustrate the mechanical stresses to which the parts have been exposed.

Mr. Dall's paper suggests to me what I believe is a new way in which to consider natural selection in its relation to dynamic influences. In their mutual relation it is clear that natural selection is not a new force coming in where dynamic influences cease; but rather it comes as a corollary of dynamic influences. It is not a foreign force, acting in some other and special way; but it acts in harmony with, and as a natural outcome of dynamic influences. If dynamic forces tend to push a series of organisms in any given time of variation, some individuals will evidently be pushed further on that line of variation than other individuals, on account of greater plasticity or other causes. Those which have yielded most fully to the acting forces will be as a necessity more completely in harmony with the mechanical requirements of the environment; therefore they will be more likely to successfully propagate and hand down the modified features which fit them for the environment, and have been fitted on to them by the environment. That such individuals will propagate especially freely may be legitimately inferred from the well-known principle, that complete harmony with environment is one of the prime factors in the successful reproduction of animals and plants. Such especially well-fitted individuals are not exceptional and sporadic cases; they are in direct accord with the ascendant line of the series to which they belong, and would therefore be naturally selected because they have most completely filled the mechanical requirements of their environment. During successive generations individual advantages naturally selected on this principle will not tend to become merged and lost sight of in the general average; they will tend to elevate and bring into greater perfection of equilibrium the oncoming generations.

ROBERT T. JACKSON.

Poulton on the Colors of Animals.[1]—The meaning and uses of animals are stated systematically in this monograph, a valuable addition to the literature of this department of natural history. The classification shows an intimate knowledge of the subject from personal observation and a wide acquaintance with the studies of others, whether embodied in occasional papers or the proceedings or transactions of various scientific societies. Mr. Poulton adopts the general title, "The Colors of Animals," in order to indicate the contents of this volume, although the majority of the examples are taken from insects, chiefly from a single order, the Lepidoptera.

In investigating the physical cause of animal colors, their production is conveniently grouped under two heads,—*pigmentary* and *structural*. The first includes, under a first head, colors caused by absorption, the effects varying with the chemical nature of the substance (pigment). The second head includes the colors produced in all other ways, the efficient cause being the structure of the substance rather than its chemical nature. No pause is made to discuss the details of the causes of color by absorption, except to mention the observance of vibrations of very different rates. The existence of vibrations of light above and below the visible series is proved in other ways, and reference is made to the conclusion reached by Sir John Lubbock ("The Senses of Animals") that it is certain that some animals can see vibrations which do not affect our eyes. The slowest vibrations that we can see produce the effect of red; the most rapid, the effect of violet; "while the intermediate vibrations cause the other well-known colors of the rainbow or the spectrum."

The white markings of animals are produced in various ways. The writer explains the snow-like appearance of white hairs and feathers by the number of minute bubbles of gas which are contained in their interstices. "Interference colors," due to thin films of air included between layers of horny consistence, are then treated with reference to their probable production of iridescent coloring. In some cases it is supposed that the chinks between the layers of tissue are kept open by films of liquid, producing the brilliant metallic appearance of many chrysalides. An interesting observation showed a brilliant golden beetle lost all its lustre after hibernating in captivity, but entirely regained it after drinking some water. After brief consideration of the colors due to diffraction and refraction (prismatic

[1] The Colors of Animals, their meaning and use, especially considered in the case of insects. By Edward Bagnall Poulton, M.A., F.R.S. With chromo-lithographic frontispiece and 66 figures in text. New York: D. Appleton & Co.

colors), the writer passes to the uses of colors, the chief object of this inquiry.

Mr. Poulton supports his own theory of the direct physiological value of the uses of color to animals by a large amount of experimental evidence brought together from many sources. Some interesting conclusions were brought forward by Lord Walsingham upon the predominance of dark varieties of insects and white varieties of birds and mammals in northern latitudes. The most widespread use of color appears to be its assistance to an animal in escaping from enemies and in capturing prey; the former is called Protective, the latter Aggressive Resemblance.

The general recapitulation of the colors of animals gives (1) non-significant colors; (2) significant colors, which are subdivided into colors of direct physiological value, protective and aggressive resemblance, protective and aggressive mimicry, warning colors, and colors displayed in courtship. Mimicry is an important section of special resemblance; when an animal gains advantage by a superficial resemblance to some other species which is well known and dreaded, because of some unpleasant quality, it is called protective mimicry; when, however, an animal resembles another so as to be able to injure the latter, the mimicry is considered aggressive.

Warning colors are advantageous to enable an animal to escape experimental "tasting," for, when it possesses an unpleasant attribute, it is well to advertise the fact as publicly as possible by conspicuous patterns and strongly-marked colors. The colors and markings of butterflies and moths often represent some familiar appearance of withered or decayed leaves. A detail of great interest is added to the disguise by the semblance of a small hole to indicate piercing by insect larvæ. Mr. Poulton allows himself to say that *perhaps* the most perfect concealment attained by any butterfly is seen in the genus Kallima, described by Wallace. This resembles in outline a withered and somewhat shriveled leaf, when at rest; along the supposed leaf runs a distinct mark like a mid-rib, with oblique veining on either side.

The color and markings of birds' eggs are supposed to be of high protective value as observed in their natural surroundings.

Some remarkable instances of rapid adjustment are cited in the chapter on "Variable Protective Resemblance in Vertebrata," etc. Fishermen know that trout caught in a sandy-bottomed stream are light colored, while those caught in a muddy stream are dark. "It is also well known that the same fish will soon change in color when it passes from one kind of background to the other." Other animals possess the

same power of adjusting their color to correspond with a peculiar environment. It is well known that the common frog can change its tints to a considerable extent. In asserting that the changes of color depend upon the eye, and blind animals cannot vary their color protectively, Mr. Poulton supports his position by the results of the investigations of Lister, Brücke, and Pouchet on the physiological mechanism of these rapid changes of color. The change of color in Arctic mammals is a difficult problem. The seasonal change of color in birds is referred partly to aid in concealment, and also to loss of susceptibility to cold supposed to result from the white winter coat.

A never-failing interest attaches to the subject of "Warning Colors." The history of the discovery of warning colors in caterpillars is quoted with many examples, showing that the education of enemies is assisted by the fact that "warning colors" and patterns often resemble each other, and there is abundant evidence to show that insect-eating animals learn by experience. By a natural transition the writer passes to a consideration of colors and markings which direct the attention of an enemy to some non-vital part, and which are not attended by unpleasant qualities. An inquiry of great charm directs attention to the importance of recognition markings, and the principles as set forth by Messrs. Wallace and Tylor. A familiar illustration will occur in the white upturned tail of the rabbit, by which the young and inexperienced are shown the way to the burrow by the individuals in advance of the expedition.

In discussing the mimetic appearances of unprotected classes, it is made plain that the term mimicry is used for convenience, for the mimicking is of course unconscious, so that the use of the word is not likely to mislead.

Mr. Poulton believes that the habits of Bower Birds are evidence for the existence of strongly-marked æsthetic taste in birds.

In conclusion, Mr. Poulton brings together the results arrived at by investigations, and shows their relation to each other in a system of classification. A detailed table gives the colors of animals classified according to their uses, one or more examples accompanying the definition of the terms, not those used in the body of the book, which were better adapted to illustrate the meaning. The writer believes that existing knowledge is well represented by the provisional arrangement suggested by this table. The book is thoroughly illustrated; the frontispiece is a chromo-lithographic plate exhibiting remarkable instances of mimicry in South African butterflies. Mr. Poulton's scientific work has been inspired by his firm resolve to support, in however

small a degree, and to illustrate by new examples, the great principles of biology enunciated by Darwin, and in especial "the preëminent principle" of natural selection.

To the above general description of Mr. Poulton's work, which we take, with some alterations, from a contemporary, we add the following comments:

The author remarks in his preface: "It is common enough nowadays to hear of new hypotheses which are believed (by their inventors) to explain the fact of evolution. These hypotheses are as destructive of one another as they are supposed to be of natural selection, *which remains as the one solid foundation upon which evolution rests.*"[2] As this book is a conspicuous example of the type of thought which regards natural selection as the cause of evolution, we give some attention to its method of treatment of this interesting question. This treatment consists, as in the case of other post-Darwinians, as Wallace, Lankester, etc., in a failure to consider the problem of the origin of the variations between which there is a struggle for existence, and which are therefore the materials of natural selection. It would appear that these scientists are generally insensible to the fact that there is any such question. I say generally, for occasionally each of them slips into an attempt to assign some physical or mechanical cause to a variation. The question will not down, as is illustrated in several places in Mr. Poulton's book. One which cannot be avoided is the question of the origin of significant colors, where our author, in one short sentence, "gives away" the whole question. On page 13 he remarks: "All animal color must have been originally non-significant, for although selective agencies have found manifold uses for color, this fact can never have accounted for its first appearance." The prompt avoidance of the question of origin, however, immediately follows, as he goes on to say: "It has, however, been shown that this first appearance presents no difficulty, for color is always liable to occur as an incidental result." We should like to know something about the origin of color and its distribution in animals, but of this we find scarcely a hint in the entire book. On the other hand, the book consists of full and rich illustrations of the utility of color shades and patterns after they have been produced.

The question of mimicry is fully illustrated and discussed, and the conclusion is reached that its existence can be fully explained by natural selection. The real question of the origin of mimetic coloration is not considered, except in a foot-note on page 224. The

[2] The italics are our own.

author quotes Mr. Skertchly as endeavoring to explain the origin of such coloration as follows: "This theory 'presupposes (*a*) that danger is universal; (*b*) that some butterflies escape danger by secreting a nauseous fluid; (*c*) that other butterflies *noticed this immunity;* (*d*) *that they copied it.*' The opinion expressed in the words I have italicised will hardly be accepted by a single naturalist. I imagine that even the American Neo-Lamarckians do not follow their founder so far as to believe that the volition of an animal could account for all the details of mimetic resemblance."

Both Mr. Skertchly and his critic illustrate the misunderstanding which may arise from a neglect of the physiology of the origin of variations. Yet the great value of the present work consists in the fact that it is a mine of information for the investigator in this direction. Thus, on page 113 and afterwards are narrated the author's remarkable experiments on the imitation by the pupas of butterflies of the colors of the bodies to which they are attached; experiments already commenced by Mr. W. W. Wood, Prof. Meldola, Mrs. McE. Barber, Mr. Mansel Neale, and others. Green, yellow, and reddish-brown surroundings were closely imitated by the colors of pupas of the same species placed in proximity to them. Mr. Poulton found with pupas of *Vanessa urticæ*, which have normally some gilt spots, that when they were placed within black surroundings they were, as a rule, extremely dark, with only the smallest traces, and often no trace at all, of the golden spots which are so conspicuous in the lighter forms. He then tried white surroundings on 150 chrysalides. In this case "not only was the black coloring matter, as a rule, absent, so that the pupas was light-colored, but there was often an immense development of the golden spots, so that in many cases the whole surface of the pupas glittered with an apparent metallic lustre." A gilt background was then employed, with the result that a much higher percentage of gilded chrysalides, and still more remarkable individual instances, were obtained.

That these results are due to the direct influence of the light reflected from the surrounding surfaces on the body of the pupas seems extremely probable. The analogy, suggested by Wood, to photographic process, is probably correctly rejected by Poulton as an explanation, though that some analogous process is at work seems very probable. The fact that where the color when once produced cannot be changed by exposure to another color, urged by Poulton as conclusively disproving Wood's theory, has no such value, since the process is one which is coincident with growth, and cannot be

seconded any more than a sensitive plate once used can receive a second photographic impression; nor is it necessary with Mr. Skertchly to suppose that the pupa "notices" the color of its surroundings, though we do not know whether it is conscious of them or not. I have myself suggested[3] that mimetic analogy is to be explained by the impression produced on the reproductive elements by a sense impression, as in the cases of "maternal impressions," of which some real cases exist. Nor does such a theory require that any "volition" be present, such as Mr. Poulton ascribed to "the founder" of American Neo-Lamarckianism. Such a hypothesis is confirmed by a fact mentioned by Mr. Poulton on page 238. He says: "This example enforces a conclusion arrived at by the study of mimetic butterflies in all parts of the world,—that the females are far more liable to assume this method of defense than the males. Thus Mr. Wallace found that the eastern Morphidæ and the special group of swallow-tails were only mimicked by the females of other swallow-tails; and similar facts have been observed in America." The male young have developed beyond the effects of the impression, while the female young have not.—E. D. Cope.

Billet on the Life History of Bacteria.[4]—In addition to elborate laboratory work with the *Cladothrix dichotoma*, *Bacterium balbianii*, *Bacterium osteophilum*, and *Bacterium parasiticum*, following them step by step through the filamentous, dissociated, entangled, and zoogloeic states, and giving conclusive proof that the present classification of microbes is erroneous, this work has a bibliographic index of 662 references, including the names of over four hundred authors.

The author does much to clear up the history of this subject, and also points out clearly that more attention has been paid to the effects upon the animal economy than to the morphology. He calls attention to the fact that the "Cohn school" declares for one unchangeable form, and that Zopf merely specifies types according to the forms.

Billet very properly claims that one form may be derived from another, and cites that Ray Lankester first recorded that the forms were not sufficient for classification, the latter being confirmed by Cienkowski. Billet shows that the bacterium (the short rod form) is able to take on sufficient length to represent the bacillus; that a number of these can form chains; and that the vibrio is found in different media to change into the spirillum. He follows the cladothrix through

[3] Proceedings American Philosophical Society, 1871, p. 261. Origin of the Fittest, p. 213.

[4] Contribution a l'étude de la Morphologie et du Développement des Bacteriacées, par Albert Billet, Docteur en Medecine, Medecin-Major, 2 Classe.—*Bulletin Scientifique de la France et de la Belgique*, 1890.

all the known forms of microbes, and shows that these microorganisms have different powers of receiving stains according to their ages.

If he be correct in the foregoing statements, many genera will be done away with. It is very interesting to follow his experiments showing the growth and development of one form into another, noting his methods of detecting the cells, etc., which methods show much labor and careful manipulation.

In treating of the typhoid germ he claims that it is not chromogenic. The work shows a marked difference in the various forms of the *Bacterium balbianii* (found in marine algæ), and the *Micrococcus prodigiosus* and the *Bacillus violaceus*, and follows them through the filamentous, dissociated, entangled, and zooglœic forms; it shows that they can live in air and may resist 100° C., that they assume an orange color on the surface of certain solid media, and that they undergo endogenous spore formation. It also shows that the *Bacterium osteophilium* is mostly found in macerated human bone surrounded with yellow fat, and that this also undergoes endogenous spore formation. He shows an evolution cycle, divided into the filamentous, dissociated, entangled, and zooglœic states. These different states correspond to a morphological grouping, and are due to the nutritive media, temperature, pressure, amount of oxygen, etc. Consequently, many morphological forms represent the same species. The zooglœic state merely represents a state of preservation. As has been said, the forms cannot determine the genera; and as we do not know at present the principal genera, we must not attempt to classify them.

It will be seen that Billet is working in the right direction to reduce bacteriology to an exact science.—S. G. Dixon.

Corals and Coral Islands. By James D. Dana.—About a half-century ago two exploring expeditions were almost simultaneously circumnavigating the globe; one under the command of Captain (afterwards Admiral) Fitzroy of the English Navy, the other under the command of Lieutenant (afterwards Admiral) Wilkes of the United States Navy. These two expeditions are chiefly memorable for the work of two brilliant young naturalists by whom respectively they were accompanied. In the English expedition went a recent graduate of Cambridge, Charles Darwin, whose dust now rests in Westminster Abbey near to that of Sir Isaac Newton, and whose discovery of natural selection—the law of gravitation of organic nature—makes his name an epoch-making one in science since that of Newton. In the American expedition went a recent graduate of Yale, who still lives, full of years and honors, his eye not dim and his natural force not abated, facile princeps of American geologists, James D. Dana. Among

the results of those voyages, the most important (excepting, perhaps, the influence of the experiences of travel upon the growing minds of the great naturalists themselves) was the theory of the origin of barrier reefs and atolls, independently developed by Darwin in the study of the coral formations of the Indian Ocean, and by Dana in the study of those of the Pacific.

The problem of barrier reefs and atolls may be briefly stated. The reef-forming corals grow only in shallow water, seldom, if ever, reaching a depth of much more than one hundred feet. Their skeletons are broken by the waves, and their comminuted fragments consolidated into the reef rock. A belt of reef is thus naturally formed immediately adjoining the shore of a continent or island, or separated from the shore by a shallow channel, having a width of a mile, more or less. Such a channel is very apt to exist, since the water immediately in contact with the shore is apt to be too impure for the luxuriant growth of corals, while the conditions are most favorable for such growth on the outer margin of the reef. Such a reef is called a fringing reef, and its formation presents no perplexing problems. But the case is very different with the barrier reefs, which are separated from the shore of the continents which they border, or of the islands which they surround, by a deep channel, ten, twenty, one hundred, or more miles in width; and with the atolls, which are more or less irregular rings of reef rock, entire or broken by channels, standing out in mid-ocean away from any land, and enclosing lagoons, which are sometimes small and shallow, but which sometimes have a diameter of scores of miles and a depth much exceeding the limit of coral growth. On the outside of both barrier reefs and atolls the bottom generally slopes off pretty rapidly into truly oceanic depths.

The solution of the problem was given by Darwin and Dana in a theory which may be expressed in one word,—subsidence. Darwin had the priority in the formulation and publication of his views, and the theory is most commonly called by his name; but Dana's work was equally independent, and he was able to illustrate the theory with a much more extensive series of observations than Darwin had the opportunity to make. It seems, therefore, most just to link together the two illustrious names, and to call the theory the Darwin-Dana theory. Let the earth's crust in a region of coral reefs undergo a subsidence not more rapid than the rate of coral growth, and fringing reefs will obviously be converted into barrier reefs. Since the corals always grow most rapidly at the outer margin of the reef grounds, the inevitable effect of subsidence will be the widening and deepening of the channel

between the reef and the shore; and this is exactly what is required to transform a fringing into a barrier reef. If the reef was formed around an island, continued subsidence will suffice to convert the barrier reef into an atoll, the original island disappearing beneath the waters of the lagoon. Since the outer wall of the reef, though somewhat steep, is never precipitous, subsidence still continued after the formation of an atoll must diminish the size of the atoll and tend to obliterate the lagoon. The last stage of a coral island disappearing by continued subsidence is therefore a mere dot of coral rock.

The theory, in its charming simplicity, reminds one of Columbus's egg. It accounts for the facts with a marvellous perfection. And the correlation which it traces between the formation of those

> "Summer isles of Eden lying in dark purple spheres of sea,"

and the vast crustal movements involved in continental changes of level in late Tertiary and Quaternary times, opens one of those glimpses of the unity of nature which give to scientific speculation a poetic sublimity. The Darwin-Dana theory was immediately and well-nigh universally accepted. Probably the first thought of almost every geologist, when the theory was announced, was, "Why did I not think of that myself?"

The subsidence theory, however, has had a rather curious history. After an undisputed reign of a third of a century, its title to the throne has been recently questioned, and, in the judgment of some of the ablest geologists, its days are numbered. The Duke of Argyll, who often (as King James said of Lord Bacon) "writes of learning like a Lord Chancellor," has made the assumption of the certain falsity of the subsidence theory the basis of a wholesale charge against the morality of scientific men, alleging that the majority of geologists have formed a "conspiracy of silence" to suppress the new views, in order to maintain before the public the infallibility of the idolized Darwin. It is, then, with a special interest that we turn, in this new edition of Dana's classical work, to the pages in which he deals with the recent discussion of the subject, and, after the mature deliberation of a half-century, defends the theory whose discovery was one of the earliest of his great achievements.

It is undoubtedly true that both barrier reefs and atolls may be formed without subsidence. If the water off the shore of a continent or island deepens very gradually, the water near the shore line may be too impure for coral growth, and the favorable conditions for such growth may be only attained at a distance of several miles from land.

In such situations the primary condition of the reefs would be that of barrier reefs (though differing from most barrier reefs in not sloping off rapidly into very deep water). The reefs of Florida are probably examples of this sort. Moreover, it was long since recognized by Chamisso, that, if the summit of a submarine volcano (or a shoal of any origin whatever) should be within the hundred-foot limit, the coral formations thereon would naturally assume the atoll form—a ring of reef encircling a lagoon—as the result simply of the more luxuriant growth of the corals on the outside than in the middle of the reef grounds. Murray, in his theory of atolls, in addition to the more luxuriant growth of corals on the outside, calls in the solvent action of the sea-water in the middle of the reef grounds in explanation of the lagoon,—an action whose importance he seems greatly to overrate.

A strong objection to Chamisso's theory of the origin of atolls has been found in the amount of coincidence which it requires. All atolls must represent submarine volcanoes (since no other shoals are likely to occur in mid-ocean), rising to within a hundred feet of the sea-level. The occurrence of so many independent volcanoes attaining so nearly the same altitude appears improbable. Murray meets this argument with the suggestion that forces are in action which tend to reduce all oceanic volcanoes to a uniform altitude, since rain, streams, and ocean waves tend to degrade to sea-level all peaks that rise above that level, while deposits of skeletons of pelagic life tend to raise the level of shoals which are yet too deep for coral growth. An island of any height could of course be leveled in time by the combined effects of subærial and marine denudation; and, as it is not unlikely that volcanic islands may have been formed in various geological periods, it is conceivable that scores or even hundreds of oceanic volcanoes, originally of various heights, might all exist to-day in the condition of shoals. But it is certain that wave-action could never degrade an island much below the water-level. The formation of atolls with deep lagoons, on the basis of volcanic cones truncated by wave-action, would seem impossible without subsidence. The depth of the lagoons, which is generally considerable in the larger atolls, and which sometimes amounts to more than three times the extreme depth of coral growth, seems, in fact, a conclusive argument for the subsidence theory In commenting on the theory of Murray, which proposes to account for the foundation of coral islands by the accumulation of the remains of pelagic life, and to account for deep lagoons by the solvent action of the water, Darwin is reported to have said to a friend, not long before his death, that he could not understand how the water could possess so great solvent

power in the lagoon of an atoll, and so little solvent power anywhere else. We find ourselves in very much the same state of mind.

The distribution of coral formations in the Pacific accords exceedingly well with the Darwin-Dana theory. South and west of the Sandwich Islands there lies a large area nearly or quite destitute of islands of any kind. Passing southward and westward from this area —the area of maximum subsidence, according to the theory—we traverse zones characterized respectively (though with much local irregularity, as might be expected) by the predominance of small atolls and lagoonless islands, of large atolls with broad and deep lagoons, and of high islands encircled by barrier reefs, reaching at last an apparent limit to that area of subsidence in the fringing reefs of New Hebrides and the Solomon Islands.

Dana has pointed out a very interesting evidence of subsidence in the dissected form of the coast-line of the high islands encircled by barrier reefs,—narrow ridges radiating outward in "spider-leg" fashion between deep bays. A deeply-dissected coast-line, on continent or island, is rightly regarded as evidence of subsidence, since valley-making is the characteristic work of rivers or glaciers.

The limits of this article allow only a mention of the blocks of limestone on the submarine slope of Tahiti far below the reach of wave-action, and the discovery of coral rock hundreds of feet below the sea-level in the artesian borings at Honolulu, rightly regarded by Dana as evidences of subsidence.

We are inclined to find a confirmation of the Darwin-Dana theory in a consideration which many will regard as too speculative to have any weight. Although there are some exceptions, Darwin's generalization appears, on the whole, to be well established, that areas of barrier reefs and atolls are destitute of active volcanoes, while active volcanoes are found in areas of fringing reefs. If we adopt the view that the interior of the earth, though solid, is mostly in a state which might be called potential liquidity, the relations of temperature and pressure everywhere, beneath a thin, cold crust, being such that the slightest local diminution of pressure will allow extensive liquefaction,—a theory which seems perhaps most satisfactorily to harmonize the apparently conflicting indications of geological and physical evidence bearing on the subject,—it seems probable that the fire-lakes from which volcanoes are fed may be developed generally in areas of local elevation and consequent local diminution of pressure. If, then, the presence of barriers and atolls may be accepted as a mark of regions undergoing subsidence, in distinction from regions stationary or undergoing elevation,

Darwin's generalization would be seen to be not a mere coincidence, but a dynamical law.

We believe, in view of all the evidence brought forward in recent discussion, that it is altogether probable that extensive subsidences of the ocean's bed have taken place in Tertiary and Quaternary times, and that the majority of barriers and atolls are the result of such subsidence, though conceding that both barriers and atolls may be formed without subsidence.

We have devoted most of this review to the examination of the theory of barriers and atolls, in view of the interest which recent discussion has aroused. The book before us is, however, by no means a controversial work, nor is it chiefly occupied with the presentation of the Darwin-Dana theory. On the contrary, in a remarkably many-sided way, Professor Dana has given us all phases of the subject: the structure, physiology, and taxonomy of the coral animals; the mode of formation of reefs and islands; the far-reaching geological inferences which the facts suggest; the fantastic beauty of those gem-like islands; and, in sad contrast, the lack of the essential conditions of an indigenous or self-supporting civilization,—

> "Where every prospect pleases,
> And only man is vile."

The professional geologist will turn to the book for the latest and most matured views of one preëminently entitled to speak with authority. The student will find in it a well-digested encyclopedic work of reference. The general reader will follow with delight the steps of one who, with a love of nature so pure and childlike,

> "—— Wandered where the dreamy palm
> Murmured above the sleeping wave;
> And through the water clear and calm
> Looked down into the coral cave."

In regard to the externals of the book, it is enough to say that the publishers have got it up in a style worthy of the contents. The book is richly illustrated. In this edition several new maps are added, and a few beautiful colored plates of corals and sea-anemones.—Wm. North Rice, in *New Publications.*

General Notes.

GEOGRAPHY AND TRAVEL.

Honduras.—The geography of Honduras is too well known to be here treated in a detailed manner. Its territory stretches from north latitude 13 degrees 10 minutes to 16 degrees, and in west longitude between 83 degrees and 89 degrees 45 minutes.

Honduras contains 46,000 square miles, with a population of about 450,000. Of these we may reckon 35,000 as belonging to the white race; the remainder is composed mainly of Indians, Caribs, and mixtures.

The country is of a very mountainous character. A series of large streams drain Honduras, mainly toward the north and south. On the Pacific slope of the Cordilleras we have two main streams, the Rio Choluteca and Rio Goascoran, both entering the Gulf of Fonseca. The north coast is better supplied with streams. We encounter the rivers Cuyamee, Chamelican, Rio Ulna, Rio Caballo, Rio Caymanes, Rio Patook, and a number of others which, though large enough to float canoes, are not of sufficient importance to be mentioned in this general geographical sketch of Honduras. The rivers Ulna and Patook, which have their sources far in the interior near Comayagua and Tegucigalpa, are most important for navigation. Although at present scarcely navigated except with small boats, they might be with little expense, made navigable for river steamboats with light draft. These two rivers traverse one of the richest territories of Honduras, covered with a luxuriant growth of valuable wood, well adapted for raising coffee, sugar cane, cocoanuts, cocoa, cotton, and a great number of agricultural products. The mountains are traversed by lodes of gold and silver ore; also copper, lead, zinc, mercury, and coal occur; and yet the whole district is entirely undeveloped in spite of the navigable rivers Ulna and Patook, which connect the rich interior with the Atlantic ocean.

In a northeasterly direction we have the Rio Segovia, entering the Atlantic at the Cape Gracias a Dias. This river forms for hundreds of miles the boundary between the Mosquito territory of Honduras and Nicaragua. Though one of the largest rivers of Honduras, its course, as well as the territory through which it passes, is nearly unknown. The banks of these rivers are inhabited by the tribes of the Payas Indians, who have not only kept their independence, but also their seclusion from the outside world.

The language spoken in Honduras is principally Spanish. In the territories inhabited by the Mayas and Mosquito Indians various dialects of the Maya idiom are encountered.

Let me commence just here a description of our journey, starting from Panama.

A large coasting-steamer has, after a voyage of seven days, safely transferred us from old Panama to the fine and magnificent bay of Fonseca.

Already accustomed to the gigantic and picturesque display of the Cordilleras on the Pacific slope, we find in the bay of Fonseca, united in the supreme works of Nature, majestic greatness and idylic beauties. A large sheet of blue water of 120 square miles extends before our eyes. From its smooth surface rise, in most variegated forms, volcanic islands; some covered with tropical vegetation, others as barren and torn as if only formed a short time ago in the wild contest of fire and water.

These picturesque groups of islands are dominated by still larger cone-shaped mountains. We see afar the volcano de San Miguel, its head crowned with black rounded clouds of smoke, which are heaped upon each other; closer to us is the famous Cosequina, and in our immediate neighborhood is the volcano de Sagate, now inactive, a ruin of a mountain, which on its ragged and torn surface, even to the present time, is bearing the marks of a terrible struggle between it and volcanic agency. The features of death imprinted upon its surface seem to have made the whole mountain destitute of animal and vegetable life. Our native guide pronounces the mountain to be haunted by the "evil spirit."

We cannot but show a badly-concealed smile while listening to a sad tale of a still sadder mountain ghost.

Our offended guide only very reluctantly consents to our proposal to hunt for the foe. We soon encountered a number of skeletons of animals, and with them his traditional bad spirit in the form of carbonic dioxyd or carbonic acid, which exudes from the interior through the open crevices of the mountain, and which proves fatal to animal life. This is the "evil spirit" the simple natives talked of.

Nearly opposite the now inactive volcano Sagate is the flourishing island of Tigre, about twenty-two miles in circumference, which forms the base of the cone-shaped, inactive volcano Tigre, about 3500 feet high, abundantly covered with vegetation. At its foot is the port and town of Amapala.

We embark, and though we are strangers to the Hondurian people, we receive at nearly every step marked attention and proofs of Central American politeness.

Our kind host is not satisfied with offering us all that his house affords. He asks us to accept with his "a la disposicion de Vm," anything that he imagines has attracted our attention. I have no doubt our host means to be sincere (?) in his *offer*, but we would most likely seriously grieve him in accepting his numerous extravagant tokens of hospitality. Most of the Hondurians are of good and noble character, hospitable and charitable toward sick people, as I myself once had an opportunity of learning. On my journey from the interior towards the north coast I was attacked with fever, when thirty miles from the nearest habitation.

A ride of thirty miles a day in a country which has no roads, but only paths over high mountains and thickly overgrown plains, is a fatiguing task, and more so for one who is sick. I arrived late at a house, asked permission to enter, which was cheerfully granted me, and during a severe illness of seven days I was carefully nursed and provided with native remedies for my complaint.

Leaving the hut and its charitable and hospitable inhabitants, I asked permission to offer, beside my thanks, a small amount of money to remunerate them for their expenses and time, but scarcely could induce them to accept money. "Senor Estrangero" (stranger), said the old Indian woman, "we have given you shelter because you have needed it; we have nursed you to restore your health, but not to have the holy duty of charity made a profitable business to us. We must refuse your money, and are contented with your thanks." A woman who takes care of a sick person is called "mujer de Dios" (woman of God). If she needs herbs or food for her patient, any one will furnish them to her, and the few words, "Soy mujer de Dios" (I am a woman of God), are more powerful in securing aid for her than money.

Life and property are well secured in Honduras. Speaking from my own experience, I never had the least difficulty in my travels through this country, and although I carried sometimes a considerable sum of money, I never was attacked or robbed. On the road I often met men carrying a large amount of crude silver and gold from the mines towards the capital and the coasts. Frequently they were not even armed, and, nevertheless, I never heard that the carrier was plundered or had absconded. The Hondurian is, as a rule, indolent, as a result of the abundant products of nature, which furnish him all he needs

with the least amount of work. But once aroused from his lethargy, he will endure harder work and more fatigue than his northern brother. Peaceable by nature and most anxious for the preservation of his health, he will, incited by the furies of war, become desperate and even cruel. His life, once so dear and precious, now becomes valueless to him. He prefers to die, face to the foe, than to retreat before a powerful enemy who attempts to invade his beloved country.

History has thrown immortal glory upon those 300 men of Sparta who fell in the defence of their country. In Honduras no records tell the story of the soldiers, buried or left where they died, far out in the wilderness. Only a number of heaps of stones with some weather-worn crosses indicate the places of rest of those brave fellows who died with the cry of "viva la patria," and no Hondurian will pass these monuments without uncovering his head and adding a new stone to his memory.

The Hondurians pass their leisure hours in gay and social entertainments, in which guitar, song, and dance form the main part. They enjoy themselves to the utmost, but the frank expression of joy is half concealed under the grave Spanish features, which seldom reproduce the sentiments of joy and sorrow.

Gambling is frequently met with in Honduras, and this vice extends to nearly all classes of society. Their national sport is equestrianism, in which they are very expert. Of their national games, we may mention hunting, bull-fighting, and cock-fighting.

The women of Honduras are superior to the men. They have the good qualities of the latter, but are more industrious, more peaceable and charitable.

Having thus given you some of the main features of the Hondurian character, we proceed with our journey from Amapala to the village of La Brea.

A small boat, with a good breeze, is rapidly ploughing its road through the bay of Fonseca, and within four hours we reach the estuaries of the Rio Choluteca which empties by seven mouths into the Pacific Ocean. We enter one of the river branches, and, pulling up through tropical forests with thick undergrowth, we reach in two hours more the village of La Brea. On our journey up the broad river our boat at times became entangled in the roots and branches of the mangrove trees, which abound on this coast.

The tree is, at present, not utilized by man, although it might become an important article of commerce on account of its containing tannin. But nature has already made use of the mangrove tree. Its

roots and branches form a kind of breastwork against the dashing waves of the sea, and not only prevent the destruction of the shores by the erosive action of the waters, but retain in the network of their roots a considerable quantity of organic and inorganic debris, carried from the interior toward the sea. As soon as the roots have accumulated enough material to form firm land, the tree dies, and new sprouts spring forth again toward the sea to recommence the same process. I have no hesitation in saying that the whole of the low diluvial and aluvial coast land on the Pacific and Atlantic shores of Honduras was formed by the aid of mangrove trees, and that the same process of formation of new land will continue as long as there are mangrove trees, and debris carried away from the interior towards the coast.

The phenomenon of a continuous process of land formation on Central American shores is certainly interesting in the *fact* itself; but more so if viewed in regard to its *causes*. We have vegetable life in mechanical and chemical co-operation with meteorology, and it results in building up new formations from mineral substances, which had once appeared in different combination and positions in the geological and topographical structure of Honduras. Nature's laws of economy thus appear before us. We see a constant change of forms in all organic and inorganic matter, but the amount of material remains stable, as well as the laws of nature.

I beg to continue with a few remarks on the natural drainage of Honduras, be it of its water or of its debris, which together must materially influence the topographical aspect of the country. The desire and intention of nature to equalize height and depth is strikingly manifested in Honduras. We would, perhaps, suppose that after the struggle of the palæozoic Hondurian continent with the tertiary epoch and its eruptions of rhyolites, basalts, and lavas, an epoch of rest, a time of peace, would follow. Our supposition is correct in one respect. The periods of continuous eruptions are over, and the undulations of the disturbed crust have ceased, with the exception of a few sudden earthquakes, which are mainly felt where large sheets of water lie above mineral substances undergoing decomposition. Meteoric events, besides, seem to stand in some direct relation with earthquakes, as we know that the latter principally occur after the rainy season, and with a low state of barometer.

Although earthquakes may cause some local disturbances, yet they are too insignificant to produce a material alteration in the character of the scenery. But at the present time a continuous change in the topo-

graphical features of Honduras is nevertheless in operation, perhaps not noticed in the short time of days, but the more strikingly in the long periods of geological ages.

These alterations of the form of mountains and valleys we may mainly attribute to meteoric agency, in particular to rainfalls, and to the lithological character of a great portion of the material of which the Hondurian mountains are composed. The rocks on the Pacific slope consist principally of rhyolite, andesite, volcanic, tufas, and augitic lavas, most of which are not apt to resist the erosive and destroying action of water and air, not only on account of friable structure, but of the want of stability in their chemical constituents. We see those mineral aggregations undergo metamorphic alterations, and thus we have, instead of the original finely crystalized hard material, accumulations of soft tufas, or common clay. A material thus altered cannot preserve its original outlines, and cannot resist the ponderous waves of water sweeping during the rainy seasons from the heights of the interior towards the level of the oceans.

There are no other meteorological records in existence which might inform us of former and ancient events in Honduras, but those which were registered by nature herself in form of striking alterations, to which the early topographical aspect of that country has been subjected during a series of epochs up to the present time.

The changes in the topography of Honduras, and principally those produced since the elapse of the tertiary period, as already mentioned, are caused by heavy falls of rain, the erosive action of which the half-decomposed rock-material could not resist; it became detached and stored away in the depths of the valleys or on the levels of the sea-shores, thus producing, after the long periods of geological ages, material alterations and changes on the surface.

At the present time the amount of water in the rivers is in direct proportion to rainfalls, and without much doubt has been always depending upon this phenomenon. We are, therefore, justified in calling those huge mineral accumulations of the diluvial and alluvial age, on the coastlands or in the interior, *direct data* and records in regard to the quantity of *former rainfalls*. In order to receive an adequate idea of the quantity of debris already used by nature for her process of building new plains, let us examine some features of the erosive action of water on the mountains themselves.

We traverse the plain between La Brea and Gnoscoran, and on entering the latter village we come upon tertiary grounds. A series of isolated volcanic mountains rise before us. Some are of the shape of a

perfect cone; others are long but narrow, their tops presenting frequently from 3 to 5 peaks or cones which are arranged in linear succession. This peculiar shape is not caused by erosion, nor can it be a mere freak of nature, as this mountain-form presents itself too often to us in our excursions through Honduras. It must be based upon similar physical and mechanical laws which we find effect the columnar, pentagonal, or hexagonal structure of a great series of volcanic rocks.

We continue our journey, and encounter, towards the interior, in a north-easterly direction from Gnoscoran, the interesting crater-ranges or crater-valleys in the neighborhood of the village of Langli. From there we proceed to the mountains of Curraren.

The official topographical map of Honduras, made in 1860, which is usually considered the most correct, proves useless to us as soon as we enter the interior mountain wilderness of Honduras. It is impossible to locate ourselves by aid of the map, as even the principal mountains and villages or towns have been too incorrectly determined in regard to their relative positions. Twice I became lost in the wild mountains of Honduras on account of some grave error in the map, having each time a narrow escape from starvation. As we proceed to Curraren we are surrounded by high walls and mountains of white andesite tufa, which are built upon each other in the form of terraces. On the white surface of the mountains numerous veinlets or lodes of mineral deposits, such as copper, silver, and lead, intersect each other, indicating, in the distance, by their greenish or reddish colored outcorps, the probable existence of some valuable mineral deposits. We really encounter the "main body" on our arrival on the top of the mountain, and find a large vein of argentiferous gold quartz, which is worked at present by some enterprising native.

It is impossible to speak of series or ranges of mountains in this district; the whole neighborhood is but a chaos of mountains, some half-destroyed or gone, others only deprived of their original "caps" of porphyry, which at one time crowned their gigantic forms.

The terraced fronts of the mountains before us are of a decidedly columnar sub-arrangement, and principally so when most exposed to the action of water and air.

The tendency of basalt, andesite, rhyolite, and a number of other eruptive rocks to assume a columnar structure appears mainly after original coherent and firm material has undergone some alteration and decomposition by aid of atmospheric influences.

There is no stability in those columnar walls, traversed with horizontal bands or layers of clay. As soon as the latter are taken away

by the action of water, the columns will fall and form a pile of debris at the foot of the mountain, till it is slowly reduced to material light enough for transportation by aid of the rains and rivers.

The duration of the picturesque aspect presented by these mountain façades is limited. With nearly every year new architectural forms of columnar structure appear, until the whole of the mountain has disappeared.

This process of continuous detachment of masses of rock is materially assisted by vegetable growth, which rises in the fissures of the walls. During the dry season the process of vegetation ceases, and dies off. The dry material usually becomes ignited, enveloping the whole district in a slowly-consuming fire. During night time the appearance of those mountain fires is fearfully magnificent. In my memory I see at the present time those burning mountains before me. I remember my hurried ride, on muleback, and I still hear the noise of the bursting and falling rocks.

The occurrence of prairie and mountain fires, principally in the hot and low regions of Honduras, contributes, to a great extent, towards a rapid decay of the present mountain forms.—M. J. R. FRITZ-GAERTNER, PH.D.

(*To be continued.*)

GEOLOGY AND PALEONTOLOGY.

The Barking Sands of the Hawaiian Islands. — The following is an abstract of a paper read on this subject read before the American Association for the Advancement of Science, at Indianapolis, August, 1890:

About a year ago I read to this association a condensed account of an examination of the Mountains of the Bell (Jebel Nagous) on the Gulf of Suez, and of the acoustic phenomenon from which it is named. In continuation of my researches on sonorous sand, which are conducted jointly with Dr. Alexis A. Julien, of New York, I have now visited the so-called "Barking Sands" on the island of Kauai. These are mentioned in the works of several travelers (Bates, Frink, Bird, Nordhoff, and others), and have a world-wide fame as a natural curiosity; but the printed accounts are rather meagre in detail, and show their authors to have been unacquainted with similar phenomena elsewhere.

On the south coast of Kauai, in the district of Mana, sand-dunes attaining a height of over one hundred feet extend a mile or more nearly parallel to the sea, and covering hundreds of acres with the water-worn and wind-blown fragments of shells and coral. The dunes are terminated on the west by bold cliffs (Pali), whose base is washed by the sea; at the east end the range terminates in a dune more symmetrical in shape than the majority, having on the land side the appearance of a broadened, truncated cone. The sands on the top and on the landward slope of this dune (being about 100 yards from the sea) possess remarkable acoustic properties, likened to the bark of a dog. The dune has a maximum height of 108 feet, but the slope of sonorous sand is only sixty feet above the level field on which it is encroaching. At its steepest part, the angle being quite uniformly 31°, the sand has a notable mobility when perfectly dry, and on disturbing its equilibrium it rolls in wavelets down the incline, emitting at the same time a deep base note of a tremulous character. My companion thought the sound resembled the hum of a buzz-saw in a planing-mill. A vibration is sometimes perceived in the hands or feet of the person moving the sand. The magnitude of the sound is dependent on the quantity of sand moved, and probably to a certain extent upon the temperature. The drier the sand, the greater the amount possessing mobility, and the louder the sound. At the time of my visit the sand was dry to the depth of four or five inches; its temperature three inches beneath the surface was 87° Fahrenheit, that of the air being 83° in the shade (4.30 P.M.).

When a large mass of sand was moved downward I heard the sound at a distance of 105 feet from the base, a light wind blowing at right angles to the direction. On one occasion horses standing close to the base were disturbed by the rumbling sound. When the sand is clapped between the hands a slight, hoot-like sound is heard; but a louder sound is produced by confining it in a bag, dividing the contents into two parts, and bringing them together violently. This I had found to be the best way of testing seashore sand as to its sonorousness. The sand on the top of the dune is wind-furrowed, and generally coarser than that of the slope of 31°, but this also yielded a sound of unmistakable character when so tested. A bag full of sand will preserve its power for some time, especially if not too frequently manipulated. A creeping vine with a blue or purple blossom (kolo-kolo) thrives on these dunes, and interrupts the sounding slope. I found the main slope 120 feet long at its base, but the places not covered by this vine gave

sounds at intervals 160 paces westward. At 94 paces further the sand was non-sonorous.

The native Hawaiians call this place Nohili, a word of no specific meaning, and attribute the sound caused by the sand to the spirits of the dead (uhane), who grumble at being disturbed; sand-dunes being commonly used for burial-places, especially in early times, as bleached skeletons and well-preserved skulls at several places abundantly show.

Sand of similar properties is reported to occur at Haula, about three miles east of Koloa, Kauai; this I did not visit, but, prompted by information communicated by Hon. Vladimar Knudsen, of Waiawa, I crossed the channel to the little-visited island of Niihau. On the western coast of this inlet, at a place called Kaluakahua, sonorous sand occurs on the land side of a dune about 100 feet high, and at several points from 600 to 800 feet along the coast. On the chief slope, thirty-six feet high, the sand has the same mobility, lies at the same angle, and gives when disturbed the same note as the sand of Kauai, but less strong, the slope being so much lower. This locality has been known to the residents of the island for many years, but has never been before announced in print. This range of dunes, driven before the high winds, is advancing southward, and has already covered the road formerly skirting the coast.

The observations made at these places are of especial interest because they confirm views already advanced by Dr. Julien and myself with regard to the identity of the phenomena on sea-beaches and on hill-sides in arid regions (Jebel Nagous, Rigii-Rawan, etc.). The sand of the Hawaiian Islands possesses the acoustic properties of both classes of places; it gives out the same note as that of Jebel Nagous when rolling down the slope, and it yields a peculiar, hoot-like sound when struck together in a bag like the sands of Eigg, Manchester, Mass., and other sea-beaches,—a property that the sand of Jebel Nagous fails to possess. These Hawaiian sands also show how completely independent of material is the acoustic quality, for they are wholly carbonate of lime, whereas sonorous sands of all other localities known to us (now over one hundred in number) are silicious, being either pure selex or a mixture of the same with silicates, as feldspar.

The theory proposed by Dr. Julien and myself to explain the sonorousness has been published elsewhere, but may properly be briefly stated in this connection. We believe the sonorousness in sands of sea-beaches and of deserts to be connected with thin pellicles or films of air, or of gases thence derived, deposited and condensed upon the surface of the sand-grains during gradual evaporation after wetting by

the seas, lakes, or rains. By virtue of these films the sand-grains become separated by elastic cushions of condensed gases, capable of considerable vibration, and whose thickness we have approximately determined. The extent of the vibrations, and the volume and pitch of the sounds thereby produced after any quick disturbance of the sand, we also find to be largely dependent upon the forms, structures, and surfaces of the sand-grains, and especially upon their purity or freedom from fine silt or dust. (Proceedings American Association Advancement Science, 38, 1889.)

"I should be lacking in courtesy to close this without expressing my great obligations to Mr. H. P. Faye, of Mara, and to Mr. George S. Gay, of Niihau, for both a generous hospitality and a sympathetic assistance in carrying out my investigations."

The speaker exhibited photographs of the locality and a specimen of the sand.

In his search after this remarkable sand, Dr. Bolton has had many interesting adventures. He thus describes his first discovery that such a thing as musical sand existed:

"I was walking along the ocean beach at a small place on the northeastern coast of Massachusetts. Suddenly it seemed a dog was barking at me with a peculiar hoarse bark. I stopped and looked around, but the barking had ceased, and there was not a dog nor a living being near. I walked on, and the sound immediately began again. I was puzzled until I looked down and found that my steps in the sand caused the noises. I then gave a vigorous kick into the dry sand, and a prolonged, dismal howl answered me, as though I had kicked a dog. I was astounded. I called some boys to me, and asked them if they had ever noticed that the sand made a noise when people walked on it.

"'Oh, yes!' they said, 'this is the famous musical beach.'

"I felt pretty cheap, for I had never heard of the famous musical beach. I asked them if there was any other place where such sand was found.

"'Not in the United States,' answered the oldest boy, 'but my papa says there is some of it in the Sandwich Islands, where he went one time.'

"When anybody tells me a thing is the only one of its kind I immediately begin to doubt it. I determined then and there to investigate the subject of 'barking' sand. That was in 1883, and much of my time since then has been occupied in my investigations. I have found the sand in small quantities in some seventy places in the

United States, one place in Mexico, one in South America, one in the Sandwich Islands, and one in Arabia."

In 1888, Dr. Bolton went to Arabia, where he had heard there was a beach of the remarkable sand. When he reached that country he found a journey of two weeks across a terrible desert would be necessary to reach the beach, which was on the Gulf of Suez. The Arabs had heard of the "singing" sand, and had a superstitious fear of it. The sheik of the tribe where he was refused to send any of his men with the explorer. Finally, persuasion and gold won him, and a caravan of fourteen camels and as many men set out. There was not a drop of water, no vegetation, no food,—only glaring, drifting sand. All the water and all the food had to be carried with them. It was four weeks before the caravan returned from the desert. It came back worn, weary, and nearly famished, but triumphant, for Dr. Bolton had found the finest beach of musical sand he had ever seen.

Last year he went to the Sandwich Islands, and found more of the sand, just as the little boy had said when he gave the doctor his first information about this curious natural formation. In Southern California is a huge sand-dune, on which are patches of the musical sand. This dune is about seventy feet high; shaped like the half of a lens. The following legend is connected with the spot:

Many years ago there was a flourishing monastery at this place, but, owing to the wickedness of the monks, it was overwhelmed by drifting sand. The monastery bells, however, were not involved in the fall of the monks, having been blessed with due ceremony by high ecclesiastics, hence the sound of these holy bells are still heard at matins and vespers. The only similar sonorous dunes known are Jebel Nagous, in Arabia, Rig-i-Rawan, in Afghanistan, and one of a similar name in Persia, Nohili, in Kauai, and possibly one in Churchill county, Nevada.

On Two New Species of Mustelidæ from the Loup Fork Miocene of Nebraska.—Stenogale robusta sp. nov.—Established on a left mandibular ramus which lacks only the posterior border, and which contains in place the molars two to five inclusive, and the root of the canine. The technical characters are those of Stenogale Schlosser, differing only from Mustela in the cutting-blade of the heel of the inferior sectorial. The species is much more robust than those referred to the genus by Dr. Schlosser. The inferior border of the ramus below the coronoid process, is obliquely flattened, and inflected in a way not seen in the *Mustela pennantii*, forming a strong inferior border to the masseteric fossa. The dental foramen is a little

above the angle of this inflection, and is below the middle of the coronoid process. There are several small mental foramina. The canine tooth is of large size. The fourth premolar is close to it, and is one-rooted. Other premolars with compressed crowns, the first with a weak posterior cutting lobe. The sectorial has the proportions seen in Mustela, and possesses a well-marked metaconid. The blade of the heel is external, and there is a low internal basal cingulum of the heel only. Tubercular molar small, one-rooted.

Measurements.—Length of dental series, 47 mm.; diameter of base of canine, 7 mm.; length of premolar series, 22 mm.; length of sectorial, 12 mm.; length of heel of, do, 5 mm.; depth of ramus at P. M. $\frac{4}{4}$, 13 mm.; do, at sectorial, 14 mm.

The depth and thickness of this ramus are identical with those of the jaw of the *Mustela pennantii*, but the length is considerably less.

Brachypsalis pachycephalus gen. et. sp. nov. *Char. gen.* Dental formula: I.?; C. $\frac{1}{1}$; P. M. $\frac{4}{4}$; M. $\frac{1}{2}$. Inferior sectorial with a wide basin-shaped heel, which is as long as the contracted blade; a metaconid.—This genus has the dental formula of the typical Mustelæ, but it is extremely microdont, having a small sectorial blade and wide basin-shaped heel as in the genus Lutra, to which it is evidently allied.

Char. specif.—Founded on a left mandibular ramus which lacks the portions anterior to the canine, and posterior to the coronoid. The sectorial is the only tooth preserved. Posterior border of the heel lobulate. P. M. $\frac{4}{4}$ well developed, one-rooted. P. M. $\frac{3}{3}$ with the anterior root reduced. P. M. $\frac{2}{2}$ and $\frac{1}{1}$ very robust, no. $\frac{1}{1}$ shorter than the sectorial. M. $\frac{1}{2}$ robust, the root grooved on each side. At the P. M. $\frac{1}{1}$ the ramus is twisted externally. The anterior face of the coronoid is as wide as the ramus at the sectorial, and the M. $\frac{1}{1}$ is in front of its internal border. The dental foramen is behind the base of the coronoid, a little nearer the alveolar level than the inferior border of the ramus. Masseteric fossa strongly defined in front and below, and with a distinct median fundus.

Measurements.—Length of dental series from and exclusive of canine, 55 mm.; length of premolar series, 31 mm.; length of sectorial, 14.5 mm.; length of heel, 7 mm.; width of, do, 8 mm.; depth of ramus at sectorial, 25 mm.; width of base of coronoid just behind M. $\frac{1}{2}$, 14 mm.

This very robust species represented the otters in the central part of North America, during the Loup Fork epoch. Its dimensions were

probably about those of the sea-otter (*Enhydris marina*). No form representing the otters has been known hitherto from this region; but a much smaller species, *Lutrictis lycoptamicus* Cope, has been described from probable Loup Fork beds of Oregon.—E. D. COPE.

Macfarlane's American Geological Railway Guide.[1]—This book is one of especial utility to the geologist, since it is an index to the book of nature, whose pages are disclosed to us in the railway cuttings of the country. Such exposures are the principal source of geological knowledge in the eastern region of our continent, where the generous rain-fall covers the natural scars and abrasions of the earth's surface with ample vegetation. The preparation of such a work was a happy inspiration of the late James Macfarlane, and that a second edition is called for shows that it has met with deserved appreciation. The authorities of the country are generally cited, and information is compiled from all available sources. We think a few more maps would be of much utility. We also find the treatment of the Cenozoic formations to be less thorough than that accorded those of the ages which preceded them. The nomenclature adopted is generally that required by priority, the only exception being found in the reports of Messrs. S. F. Emmons and G. K. Gilbert, of the U. S. Geological Survey, where some names are used which are not warranted by the law of priority or by general custom. Such is the use of Niobrara instead of Loup Fork. Niobrara is the name of a Cretaceous horizon, and has nothing to do with the Loup Fork Miocene.

A Catalogue of British Fossil Vertebrata.[2]—This work supplies a want that paleontologists have felt who are desirous of learning the extended literature of vertebrate paleontology as developed by Englishmen or on English material. This literature is largely prior, of course, to that of America, and it is especially important for Americans to become acquainted with the sources of information and of nomenclature so far as they apply to the paleontology of their country. In this work they will find it fully indexed, and full references given. A nomenclature has been adopted by the authors, so far as it has been personally investigated by them, based on the rules promulgated by all scientific bodies; but in cases where they have followed others they have not adhered to them in that one

[1] An American Geological Railway Guide. By James Macfarlane, Ph.D. Second edition edited by James R. Macfarlane. New York: D. Appleton & Co. 1890. 8vo. pp. 426.

[2] A Catalogue of British Fossil Vertebrata, by Arthur Smith Woodward and Charles Davies Sherborn. London: Dunlan & Co., 37 Soho Square. Jan., 1890. 8vo. pp. 398.

which requires a diagnosis or description for every name as a necessary condition of priority. Thus we find Platychœrops, Protosphyræna, and Hipparion, for which their authors published no separate diagnosis, adopted instead of Miolophus, Erisichthe, and Hippotherium, which were accompanied by diagnoses when first proposed. We hope that in a second edition the work may be made uniform in this respect.

The Cretaceous Saurians of New Zealand.—Prof. James Hector's explorations in New Zealand have led to the accumulation of several tons of blocks of cement-stone containing fossil bones, which have been worked out of the hard matrix by Mr. McKay. The general result is that portions of 43 individual reptiles, mostly of gigantic size, and all of aquatic habits, belonging to at least 13 distinct species, have been discovered. These species represent two distinct groups, the first being true Plesiosaurians belonging to the genera Plesiosaurus, Maurisaurus Hector (gen. nov. allied to Elasmosaurus Cope), and Polycotylus Cope; the other representing probably the order Pythonomorpha. This order is represented by two distinct genera, Liodon Owen and Taniwhasaursus Hector (gen. nov. allied to Clidastes of Cope). In addition, there are several fragmentary remains, placed provisionally under one or the other of these groups, and two vertebræ belonging to an exceptional form of the genus Crocodilus. Lastly, there is a single vertebrate from Mt. Potts referred to the genus Ichthyosaurus. Plates with descriptions of these interesting fossils are found in the Transactions New Zealand Institute, Vol. VI. A fine series of these saurians has been recently received in Philadelphia by Prof. Cope, who will add them to his private collection.

A Bison at Syracuse, New York.—A bovine skull was exhumed (in laying a sewer) from about ten feet below the surface of the ground, at Syracuse, N. Y. The formation was of black swamp muck underlaid by clay; the skull being found at the junction of the two deposits. No other bones were found. I append a few measurements: Foramen magnum (superior border) to occipital crest, 4½ in.; width of condyles, 5¼ in.; width of skull between horns and eyes, 10¼ in.; width of skull between meati audit. ext., 9⅝ in.; from foramen magnum to end of premaxillæ, 20 in.; width from zyg. arch to its fellow, 9⅝ in.; width of palatines opposite last molar, 3¾ in.; width across premaxillary bones, 4 in.; length of alveoli, 6⅝ in.; nearest approach of orbits to each other, 10½ in.; length of nasals, 8½ in.; width of nasals, 2½ in.; occipital crest to nasal, 10¼ in.; frontal suture closed except 2½ in.; circumference of horns at base, 14 in.; length of horn,

greater curvature, 15½ in.; length of horn, lesser curvature, 10 in.; distance from tip to tip of horns, 17¾ in.; distance from base to base of horns, 10¼ in.—LUCIEN M. UNDERWOOD, *Syracuse University, Syracuse, N. Y.*

NOTE BY EDITOR.—Photographs of this skull sent by Mr. Underwood show that it belongs to the bison, *Bos americanus*. This is, I believe, the most northern locality at which it has been found east of the Mississippi valley.—E. D. COPE.

Geological News.—Palæozoic.—In a review of Dr. Ells's Report on the Geology of a Portion of the Province of Quebec, C. D. Walcott agrees with the author in condemning the name Quebec group. In view of many new facts brought to light by the study of the past fifteen years it has become misleading and unintelligible. In its stead Dr. Ells's proposes to use the name Levis for the local development of the Calciferous terrane about Quebec, and the name Sillery for the passage beds and Cambrian strata of the St. Lawrence valley in the vicinity of Quebec. This suggestion has the hearty endorsement of Mr. Walcott.

C. R. Van Hise (Bull. Geol. Soc. Am., Vol. I., pp. 203–244) confirms Newton's views as to the eruptive origin of the granite core of the Blacks Hills, and its pre-Cambrian age. He further states that the zone of schists about it was developed and deeply eroded before the beginning of Palæozoic time.

Sir Wm. Dawson and Dr. G. J. Hinde have recently described some new species of fossil sponges from the Siluro-Cambrian at Little Metis, on the lower St. Lawrence. These specimens are especially interesting since they throw fresh light on the character of the earliest-known forms of these organisms, and their discovery is the more opportune from the fact that our knowledge of the existing hexactinellid sponges —the group to which nearly all these fossils belong—has been vastly increased by the work of Prof. F. E. Schulze, of Berlin, on the hexactinellid sponges dredged up by the Challenger Expedition, and thus we are now better enabled than hitherto to compare the fossil and recent forms. Twelve species, representing six genera, are described and figured.

The second part of the Contributions to the Micro-Paleontology of the Cambro-Silurian Rocks of Canada has been prepared by E. O. Ulrich. It consists of a descriptive report on some fossil Polyzoa and Ostracoda from Manitoba, and is illustrated by two full-page litho-

graphic plates. Of the twenty-five species of Polyzoa eleven are new. The Ostracoda are few, and not in good condition. There are but nine species in all, five of which are new.

The study of the Calciferous formation in the Champlain valley by Profs. Brainard and Seeley has brought a series of surprises: 1. The thickness of the rocks,—little less 2000 feet. 2. The amount of magnesian limestone. 3. The amount of pure limestone. 4. The abundance of fossil forms. 5. The almost entire exclusion of the bird's-eye formation from the Vermont rocks. (Bull. Geol. Soc. Am., pp. 501–516.)

In the Proc. U. S. Nat. Mus., Vol. XII., are found descriptions by C. D. Walcott of fossils from the Lower Cambrian. Of seven corals, two, *Archæocyathus dwightii* and *Ethmophyllum meekii*, are new species. Of worms and molluscs there are three new genera and thirteen new species.

In a report on the Natural Gas in Minnesota Prof. N. H. Winchell makes the following statement: "So far as science affords any evidence in favor of gas below the Trenton limestone in Minnesota, there is perhaps one chance in ten that the formation which is known in the northern part of the State as *Animike slates* and *quartzites*, underlies the county of Freeborn at a depth of 3000 feet. In case it were found at that depth there might be one chance in one hundred that it would contain some gas, and one in a thousand that it would afford enough for economic purposes." (Bull. No. 5, Geol. and Nat. Hist. Survey, Minn.)

Prof. Edw. Orton states as a law that "The pressure of Trenton limestone gas is due to a salt-water column, measured from about six hundred feet above tide to the level of the stratum which yields the gas." (Bull. Geol. Soc. Am., Vol. I.).

In view of the fact that the use of the name Hudson River group has been attended with more or less uncertainty ever since it was promulgated by the geologists of the New York Survey, Mr. C. D. Walcott proposes to use the term Hudson in a generic sense to include a group of formations that occur between the Trenton limestone horizon and the Upper Silurian or Niagara horizon. (Bull. Geol. Soc. Am., Vol. I., pp. 335–356.)

Carbonic.—C. R. Keyes, in discussing variation of a carbonic gastropod, *Platycerus equilaterum* (*Am. Geol.*, June, 1889), emphasizes the fact that accidental station is not the only factor in modifying the form of the shell, but that gravitation also exerts a potent influence.

In America there are probably about a dozen valid species of Naticopsis, the others described as such being identical with forms previously known. *Patica littonana* Hall, from the Warsaw limestone, apparently belongs to the globose group of *Soleniscus*, and will therefore stand as *S. littonanus*. For *Isonema depressa* M. and W. it is proposed to substitute the name *Naticopsis linearis*. (C. R. Keyes, *Am. Geol.*, October, 1889.)

H. A. Wasmuth, in the *Am. Geol.*, May, 1888, closes a description of the Pittsburgh Coal Bed with a reference to the Devonian formations, reservoirs of gas and oil, that underlie it. Naturally, the greatest amount of gas should be found on the higher elevations (anticlinals), and of oil in the deeper portions of synclinals of the Devonian formations; but as this theory is refuted by geologists of reputation, there remains the influence of disconnections and dislocations of the oil- and gas-bearing strata by clay veins, etc., to explain the productivity of the oil- and gas-wells of Pennsylvania.

Jurassic.—R. Lydekker announces the discovery of a new crocodile, *Suchodus durobrivensis*, from the Oxford clay of Peterborough. (*Quar. Jour. Geol. Soc.*, May, 1890.)

A. Smith Woodward notes three small Ichthyolites from the Paper Shales of Wigston, referable to a small species of Pholidophorus, *P. nitidus* Egerton. (Trans. Leicester Lit. and Philosoph. Soc., April, 1889.)

R. Lydekker has referred two vertebræ, one from the Wealden of Cuckfield, the other from the Wealden of Brook, to *Pleurocœlus valdensis*. Their especial interest lies in the circumstance that, in connection with some opisthocœlous teeth, they afford absolutely conclusive evidence of the occurrence in the English Wealden of a diminutive opisthocœlous Dinosaur, which was the contemporary of the huge Ornithopsis, and the still more gigantic Pelorosaurus. (*Quar. Journ. Geol. Soc.*, May, 1890.)

Cretaceous.—According to Robert T. Hill (*Am. Geol.*, 1889) the Cretaceous exposures of the Texas-Arkansas region record two subsidences. Of the total sediments of the Lower, aggregating over 2,000 feet, 1,500 are limestone, all but 100 feet of which are of foraminiferal origin. Of the 700 feet of limestone of the Upper Cretaceous formation of Texas 600 feet are of foraminiferal origin.

J. S. Newberry (Trans. N. Y. Acad. Sci., Vol. IX.) gives the following reasons for considering the Laramie the upper member of the

Cretaceous, as first determined by Cope: 1st. It contains an invertebrate fauna that has in it many Cretaceous elements; *Mactra alta*, *Cardium speciosum*, and several species of Inoceramus being also found in the Fox Hill group. 2d. It contains, according to Cope and Marsh, a vertebrate fauna which is decidedly Cretaceous in character. 3d. The somewhat numerous mammals obtained from the Laramie by Cope and Marsh are reported by them to have decided Mesozoic characters.

Cenozoic.—Some fossil fish remains found in the Oligocene strata in the Isle of Wight have been referred by Mr. E. T. Newton to the genus Clupea and named *C. vectensis*. (*Quart. Journ. Geol. Soc.*, Feb. 1889).

Of seven species of fossil butterflies from Florissant, Cal., described by S. H. Scudder, six are new, and are referred by him to five new genera. Five of the seven belong to the sub-family Nymphalinæ, one to Pierinæ. The last represents a nearly extinct type, the sub-family Libytheinæ, and is of especial interest.

M. Deydier has found in the fresh-water limestone deposits of Ratavoux, near Cucuron, a mandible of *Castor jægeri* Kaup, a true Miocene species, which has not heretofore been recorded in the Leberon fauna. (Bull. Soc. Geol. de France, Tome dix-huitiéme.)

A fossil fish found in the Pliocene deposits near Antwerp has been referred by Raymond Stomes to the genus Thynnus, under the name *T. caldisii*. (Bull. Soc. Belge de Geol. de Paleon. et d'Hydrol., 1889.)

Plistocene.—In the Trans. Roy. Soc., 1889, Dr. J. W. Spencer discusses in detail the best developed beach of the Ontario basin, to which he gives the name Iroquois Beach. He does not agree with Mr. Gilbert as to the existence of glacial barriers closing the St. Lawrence valley. Not only is it unnecessary to believe in the existence of such a barrier to keep out the sea-water, as witness the present Gulf of Obi, but it seems impossible to believe in the existence of great glacial dams above sea-level sufficiently permanent to develop such regular beaches and terraces as the Iroquois, which indicate a wave-action of as long duration as that upon the modern beaches of Lake Ontario.

According to Dr. Spencer, in a paper read before the Geological Society of America, soundings demonstrate the presence of submarine valleys reaching upon all our coasts to depths of 3,000 feet or more; that these soundings show that within comparatively short distances

from their mouths the depth of the valleys, below the surface of the sea, sometimes did not exceed from 1,200 to 1,800 feet, but that beyond there was a greater increase of depth, within the last few leagues. In the fiords of Norway, merging into rapidly-contracting valleys, or headed by great vertical walls, hundreds of feet in height, may be seen the counterpart of the coast of the American continent just preceding the Plistocene period.

BOTANY.

Botany at the Indianapolis Meetings.—In the several meetings held in Indianapolis in August, including the American Association for the Advancement of Science, the Botanical Club, and the Society for the Promotion of Agricultural Science, there were many good papers on botanical subjects; in fact, it may be said that the average rank of the papers was considerably higher than in previous years. In the sessions of the Society for the Promotion of Agricultural Science the following botanical papers were read:

1. Preliminary Note on the Rotting of the Potato, by T. J. BURRILL; detailing experiments which show that in many cases, at least, the actual cause of the rotting is a Bacterium morphologically similar to *B. termo*, but differing from that species in its deportment towards nutrient media.

2. The Rots of the Sweet Potato, by B. D. HALSTED; indicating that there are four or five apparently distinct kinds of rots, due to the attacks of as many species of fungi.

3. Some Fungous Root Diseases, by L. H. PAMMEL; referring mainly to the cotton and sunflower plants.

4. The "Scab" of Wheat-Heads, by C. M. WEED; describing a disease of wheat which appears to be due to *Fusisporium culmorum*.

5. Some Recent Observations on the Black-Rot of the Grape, by B. T. GALLOWAY; detailing the results of experiments in inoculating the grape and Virginia creeper with ascospores, pycnidiospores, etc., of Phyllosticta.

6. A Comparative Test of Some of the Copper Preparations in the Treatment of Black-Rot of Grapes, by B. T. GALLOWAY; showing that by the use of such solutions the disease may be greatly reduced.

7. Biological Factors in the Nutrition of Plants, by M. MILES; referring to the rôle of micro-organisms in plant nutrition, and giving the results of experiments upon "clover tubercles."

8. The Forage Problem on the Plains, by C. E. BESSEY; discussing the native grasses and the factors which control their distribution, and suggesting those worthy of cultivation.

9. Cucurbita an American Genus, by E. L. STURTEVANT. In this paper, after referring to the fact that Cogniaux, in his Monograph of the Cucurbitaceæ (1881), recognizes ten species, of which six are acknowledged to be strictly American, the author proceeds to show that the remaining species, viz.: *C. maxima, C. pepo, C. moschata,* and *C. ficifolia,* are also presumably of American origin. Six lines of argument seem to show that the position is well taken, viz.: (1) the absence of authentic instances of the recognition of pumpkins, squashes, etc., by the ancients of prehistoric times; (2) the sequence of the European recognition which appears in the nomenclature seems to imply an introduction after the discovery of America; (3) the vernacular names of the four species appear from historical evidence to have originated after the discovery of America; (4) the vernacular names on structural grounds appear to be of American origin; (5) herbarium specimens (very scanty in fact) indicate American as much as Old World origin; (6) in the scanty notices by older writers on Asiatic plants these species appear, either by statement or implication, to be introduced.

The botanical papers read before Section F numbered twenty-seven in all, as follows:

1. The Forest Trees of Indiana, by STANLEY COULTER; being a commentary upon the list of forest trees (106 species) of the State. The distribution appears to be dependent mainly upon the water supply, and not upon the richness of the soil, geological formation, or altitude above the sea.

2. Preliminary Notes Upon a New and Destructive Oat Disease, by B. T. GALLOWAY; calling attention to a disease which attacks the leaves and stems of the oat, causing a discoloration of the tissues. A *Bacillus* was found, and this was shown by inoculations to be the cause of the disease, which appears to be widespread, cases having been reported from New England to Illinois and southward.

3. Observations on the Variability of Disease Germs, by THEOBALD SMITH; citing certain variations by him in the bacilli of "hog cholera."

4. The Trimorphism of *Uromyces trifolii* (Alb. and Schw.) Wint., by J. K. HOWELL; detailing investigations made to show that the Æcidium of clover (*Æ. trifolii-repentis*) is genetically connected with the teleutospore stage known as *Uromyces trifolii.* By means of care-

ful infections conclusivè proof of the identity of the species was obtained.

5. Observations on the Life-History of *Uncinula spiralis* B. & C., by B. T. GALLOWAY; giving the results of a study of the germination of the ascospores.

6. On the Seed-Coats of the Genus Euphorbia, by L. H. PAMMEL. From a study of the structure of the seed-coats it is evident that distinguishing marks may be obtained from them.

7. Observations on the Method of Growth of the Prothallia of the Filicineæ, with Reference to their Relationships, by D. H. CAMPBELL. The author called attention to the similarity between the development of the prothallia of Filicineæ and the thalli of the Hepaticæ, and suggested that the two groups are genetically related.

8. Development of the Sporocarp of *Griffithsia bornetiana*, by V. M. SPALDING. A careful study of alcoholic material enabled the author to follow the development of the sporocarp step by step.

9. Contributions to the Life-History of Isoëtes, by D. H. CAMPBELL; giving many points in the development of the macrospore and the female prothallium. There are indications that Isoëteæ are related to the Marattiaceæ.

10. The Relation of the Mexican Flora to that of the United States, by SERENO WATSON; giving first a sketch of the physical features of the continent as they affect plant distribution, then recognizing and defining three botanical regions, viz.: the Atlantic, the Interior (Plains and Rocky Mountains), and the Pacific. After citing examples of families and genera the conclusion was reached that there is a closer connection between the Mexican flora and that of the Atlantic region than with that of either the Interior or Pacific.

11. Distribution of the North American Umbelliferæ, by J. M. COULTER. The Umbelliferæ of North America appear to be massed within the United States (especially northwestward), having spread southward from an Arctic and possibly from an Asiatic origin. The genus Peucedanum is the great North American umbelliferous group, and all its species are west of the Mississippi River, forty being peculiar to the Pacific States. Cymopterus is a Great Basin genus. The Great Plains contain but few species.

12. Distribution of the Hepaticæ of North America, by L. M. UNDERWOOD; referring to our meagre knowledge of our species (but 265 being known), and discussing as far as possible their general range. Four botanical provinces appear to be indicated for North America, viz.: Boreal, Medial, Austral, and Occidental, to which may also be

added the Mexican. The richest region in species is probably that extending from Washington southward along the coast, thence westward to Southern California.

13. The Migration of Weeds, by B. D. HALSTED; giving examples of the travels of some of the more common weeds of the country.

14. The Geographical Distribution of North American Grasses, by W. J. BEAL. Of the 298 genera of grasses we have 115, with 25 more introduced. Of the 3200 species in the world we have 850 natives, and 125 more introduced, making 975 in all, or considerably more than one-fourth of the whole. Bouteloua is represented by all its species (27), as is the case also with a number of smaller genera, many of which are peculiar to North America.

15. The Geographical Distribution of North American Cornaceæ, by J. M. COULTER. Of the three genera Garrya is peculiarly an American genus; its species are mainly Mexican, extending into the Pacific region. Nyssa is eastern. Cornus is doubtless of northern origin, which has, while moving southward, been separated by the Great Plains into a western and an eastern group.

16. The General Distribution of North American Plants, by N. L. BRITTON. The author divided the North American flora into a northern (British America, the Sierras, the Rocky Mountains, and the Alleghanies) and a southern region (Atlantic Coast, Mississippi Valley, and a part of California). Referring to the influence of the glacial climate, he pointed out many difficulties in the usual method of accounting for the present northern flora.

17. The Work of the Botanical Division of the Department of Agriculture, by F. V. COVILLE. Two main lines of work have been undertaken, viz.: (1) the study of economic problems, especially those relating to grasses and forage plants; and (2) systematic work upon the flora of the country. Publications in two series (economic and scientific) are made from time to time.

18. The Development and Function of the So-called Cypress "Knees," with a Consideration of the Natural Habitat of the Tree, by W. P. WILSON; showing by means of lantern slides the peculiarities of structure of the root-system of the cypress (*Taxodium distichum*) of the Southern States. Several methods of the formation of knees were fully illustrated and discussed. The conclusion was that the cause of their formation is physiological and not mechanical.

19. The Potato Scab, a Bacterial Disease, by L. H. BOLLEY. For want of time this paper was read before the Botanical Club.

20. The Continuity of Protoplasm Through the Cell-Walls of Plants, by W. J. BEAL and T. W. Tuomey; giving the results of a long series of observations.

21. Preliminary Note on the Genus Rhynchospora in North America, by N. L. BRITTON; being an enumeration of the species now known to inhabit North America.

22. On Rusbya, a New Genus of Vacciniaceæ from Bolivia, by N L. BRITTON. An interesting new genus of parasitic plants.

23. Notes on a Monograph of the Genus Lechea, by N. L. BRITTON.

24. The Specific Germs of the Carnation Disease, by J. C. ARTHUR and H. L. BOLLEY; giving the results of a very complete study of the bacterium, which is shown to be the cause of the disease.

25. Notes Upon Plants Collected by Dr. Edward Palmer at La Paz, Lower California, by J. N. ROSE. Read by title only.

26. Notes Upon Crystals in Certain Species of the Arum Family, by W. R. LAZENBY; giving microscopical details of a study of thecrystals.

27. Notes on *Isopyrum biternatum*, by C. W. HARGITT; giving the results of the anatomical study of the root-tubers.

The attendance upon the Botanical Club was very good, and the notes and papers were unusually numerous.

1. Dr. Britton, chairman of the club, in a short address upon the Present State of Systematic Botany in North America, noticed the activity in various centres by different investigators. A marked feature of the present is that there has lately been a great increase in the number of specialists.

2. Notes on Nomenclature, by B. E. FERNOW; referring to the need of a revision in both scientific and common names, and noting a considerable number of cases of recent changes in the scientific names of forest trees.

3. An Eastern Station for *Actinella acaulis* Nutt., by C. M. WEED; noting the occurrence of this western plant in Northern Ohio.

4. Notes on the Milky Juice of Plants as a Protection Against Stem-Borers, by C. M. WEED; concluding that the milky juice is a protection against stem-boring insects.

5. Notes on the Root-Tubercles of *Ceanothus americanus*, by W. J. BEAL; noting the occurrence of root-tubercles similar in appearance to those on clover.

6. The Genus Bacterium, by T. J. BURRILL; protesting against the loose practice in the application of names which prevails in bacteriology, and insisting that the genus Bacterium, which has latterly been ignored, has a right to existence.

7. A New Hollyhock Disease (*Colletotrichum althææ*), by E. A. SOUTHWORTH; giving the results of studies of this destructive disease, with an account of germinations and inoculations.

8. The Nature of Paleæ and Lodicules in Grasses, by F. L. SCRIBNER; discussing the homologies of the grass-flower and spikelet, and concluding (1) that paleæ are simply prophylla beginning the floral branch, and (2) that the lodicules are true scales belonging to the epidermal system, whose function is to expand the glumes in anthesis.

9. Two forms of *Ampelopsis quinquefolia*, by W. R. LAZENBY; differing in the structure of their tendrils, developing discs in one (native form), and not in the other (cultivated form).

10. On Pollination in the genus Æsculus, by L. H. PAMMEL; detailing the results of studies of several species.

11. Notes on the Adventive Buds of Lycopodium.

12. Notes on the Archegonia of Ferns.

13. Germination of the Spores and the Prothallia of Osmunda. Three papers by D. H. CAMPBELL, giving the results of careful structural studies.

14. Notice of a Descriptive List of the Junci of Texas, by F. V. COVILLE; referring to the work done on Junci for the forthcoming Manual of the Texan Flora.

15. Apparatus for Vegetable Physiology, by J. C. ARTHUR; showing drawing of some new apparatus made in the physiological laboratory of Purdue University.

16. Report on the Botanical Exchange Club, by F. V. COVILLE; reporting that the club is now ready to make exchanges, having on hand about 5000 specimens.

17. Plant Colonists at Akron, Ohio, by E. W. CLAYPOLE; giving a few notes upon certain common introduced plants in Northern Ohio.

18. A Serviceable Collecting Knife, by F. V. COVILLE; being, in short, the "cotton knife" of the Southern States.

19. Double Flowers in Wild Morning Glory (*Convolvulus sepium*).

20. Peculiarites of the Pollen of *Epilobium palustre* var. *oliganthum*.

21. A Supposed Hybrid between *Tragopogon porrifolius* and *T. pratensis*. Three short papers by B. D. HALSTED.

22. A Mode of Spore Discharge in a Species of Pleospora, by MISS E. PORTER.

23. Potato Scab, by H. L. BOLLEY; concluding that the disease is due to bacteria.

On Monday the club made an excursion to Garland Dell, locally known as "The Shades of Death," and had a most enjoyable time

throughout, collecting by the way many plants of interest to those less familiar with the central Indiana flora.

The officers of the club for the next year are: President, Wm. M. Canby; Vice-President, L. M. Underwood; Secretary, B. T. Galloway.

Taken all in all, the botanists of the country have no need of feeling ashamed of the quality of the work done in the association and the related societies.—CHARLES E. BESSEY.

ZOOLOGY.

Heliotropism in Animals.—Groom and Loob[1] think that the daily migrations of pelagic marine animals are to be regarded as caused by heliotropism. In the day-time this is negative, the strong light driving them from the surface; while at night it exercises a positive action, causing them to seek the surface waters. Their observations show that light, and not heat, is the exciting cause. Driesch finds[2] that heliotropism influences the growth of the hydroid Sertulariella.

Excretory Organs of Protozoa.—A. B. Griffiths states[3] that he has proved the existence of uric acid in the contractile vacuoles of Amœba, Vorticella, and Paramecium. The Amœba was killed under the cover-glass with weak alcohol. This was followed by nitric acid, the slide warmed, and then ammonia was drawn under the cover-glass, the result being the formation of crystals of murexide in the contractile vacuole itself, as well as in its excretion. This clearly shows that these organs are for the excretion of nitrogenous waste.

Note on Some Gigantic Specimens of Actinosphærium eichhornii.—In a small pond near the observatory of the State University of Iowa I collected some material which now stands on a table in the laboratory. Minute whitish discs, plainly visible, however, to the unaided eye, may be seen in considerable numbers clinging to the stems and leaves of Ceratophyllum. An examination of these discs reveals the fact that they are gigantic Rhizopods belonging to the genus Actinosphærium. *Actinosphærium eichhornii* they probably are, but they are vastly larger than any individuals of this species usually

[1] *Biol. Centralblatt.*, X., 160 and 219.

[2] *Zoolog. Jarbuch.*, V., p. 147.

[3] Proc. Roy. Soc. Edinburgh, XVI., p. 131.

seen, and larger than any recorded by Prof. Leidy in his work on the "Fresh-Water Rhizopods of North America." The first specimen I measured, in place of being 0.4 mm., the maximum diameter given by Leidy, was 0.85 mm. in diameter, with rays projecting 0.45 mm. beyond the margin of the body. There are scores of individuals in my jar, and the average diameter is in excess of 0.75 mm. The largest specimen measured had a diameter of 1.36 mm., and there are not a few individuals that seem to be equally as large.

It is worthy of record that a large proportion of the specimens that passed under the microscope had been feeding on small specimens of Cyclops. Rotifers seems to be a favorite article of diet with Actinosphærium, and even the individuals that had succeeded in capturing Cyclops contained often three or four Rotifers. Difflugia was taken by a few, but none, so far as observed, had condescended to feed on diatoms or other forms of algæ. It has been a matter of surprise that a creature so sluggish as Actinosphærium should be able to capture Cyclops. How the capture is made I have thus far not been able to determine.—S. CALVIN, *Biological Laboratory, State University of Iowa, September 20, 1890.*

Portuguese Man-of-War.—Mr. Robert P. Bigelow studied[4] the habits of the Portuguese man-of-war (which has lost its familiar name *Physalia arethusa*, and has been rechristened *Caravella maxima* in Haeckel's recent monograph). This form feeds largely on small fish; these, swimming against the tentacles, are caught and benumbed; but apparently their struggles pull the tentacle, which contracts, bringing the prey up to the numerous feeding-bells. If the fish does not struggle the tentacle fails to contract. The feeding-bells spread themselves over the fish and digest it. During the summer of 1889 these splendid siphonophores were very abundant at Woods Holl, Mass., but during the summer of 1890 not a single individual was seen.

Dimorphism in Antipatharia.—G. Brook describes[5] an interesting type of dimorphism in the Antipathidæ. In Schizopathes, Bathypathes, etc., the zooids have become elongated in the transverse axis, so that the six tentacles appear like three pairs. Corresponding with this there is a depression between the oral and lateral regions, so that from the surface each zooid appears like three lobes, each with a pair of tentacles. Internally the lateral portions are separated from the central by a mesoglœal partition, and since the lateral mesenteries

[4] Johns Hopkins Univ. Circ., IX., p. 61. 1890.

[5] Proc. Roy. Soc. Edinburgh, XVI., p. 78.

alone bear reproductive organs, and only on their distal portion, the result is that the division produces from each primitive zooid a gasterozoid flanked by two gonozoids. It is hardly necessary to say that this dimorphism is different from that in the Hydrozoa.

Acanthocephali. — The systematic position of the Acanthocephali has long been a problem, although from similarity of shape they were usually placed near the Nematodes, or round worms. Recently Dr. Hamann has been studying the subject, and finds[6] additional grounds in support of this view. He thinks that the water vascular system is homologous in each, while he recognizes the problematical acanthocephalan lemnisci in cervical or cephalic glands occurring in many Nematodes.

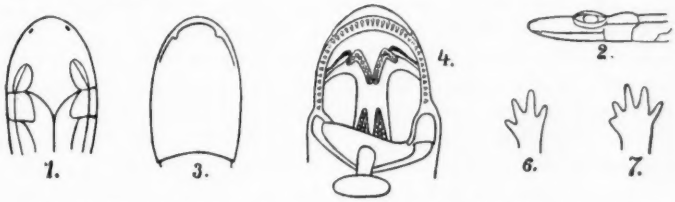
On a New Species of Salamander from Indiana.—At the time of the meeting of the American Association for the Advancement of Science of the present year, at Indianapolis, Mr. A. W. Butler, of Brookville, Indiana, presented me with three specimens of a species of Salamander which were taken in a spring near to Brookville. Two of these were living, while the third is an alcoholic specimen from a collection which embraces a number of other individuals from the same locality, belonging to Mr. Butler.

The three specimens represent young, middle-aged, and mature individuals, which have passed their metamorphosis. They agree nearly in their characters. They belong to a species which resembles the *Spelerpes longicaudus*, but are distinct in form, color, and habits, and belong, moreover, to the genus Gyrinophilus. The premaxillary bones are of feeble structure, and the spines are distinct and widely separated, contrary to the structure in the genus Spelerpes. The mature individuals, of which Mr. Butler possesses several, are much more robust than those of *S. longicaudus*, having a short body and relatively long preaxillary region and head. With this the tail is as long as in the *S. longicaudus*, and is similarly compressed. The entire animal is larger. The color is different from that of the *S. longicaudus*. It is vermilion-red, as in *S. ruber*, and the superior surfaces of the head and body are irregularly spotted with dark brown. The sides of the tail are similarly irregularly brown-spotted, the spots not showing the least tendency to form the vertical bars characteristic of the *S. longicaudus*. The form of the series of vomerine teeth is different. Instead of commencing at the posterior border of the internal nares, they commence opposite to the anterior border of the same, and

[6] *Zoolog. Anzeiger*, XIII., p. 210. 1890.

send posteriorly a short branch along the internal border of the choana, thus giving a hook-shaped outline to each series. The proportions are as follows:

Width of head five times in length of head and body. Length of head to axilla two and a third times into total length of head and body to groin. Tail one and a-half times the length of the head and body. When the limbs are extended, the posterior toes reach the distal extremities of the metacarpals. Thirteen costal folds. The width of the head is half the length to above the middle of the humerus. The canthus rostralis is distinct, though not so strongly marked as in *Gyrinophilus porphyriticus*. Total length, 152 mm.; length to angle of mouth, 8 mm.; to axilla, 23 mm.; to groin, 53 mm.; to extremity of vent, 62 mm.



Gyrinophilus maculicaudus Cope; $\frac{4}{3}$ natural size. Fig. 1, head, from above; Fig. 2, head, from below; Fig. 3, head, profile; Fig. 4, interior of mouth, $\frac{2}{3}$ natural size; Fig. 6, fore foot, from below; Fig. 7, hind foot.

In the adult specimens the subnareal processes are quite prominent. In young specimens the ground-color is yellower than in those of medium and full size.

I propose to call this species *Gyrinophilus maculicaudus*. In its habitat in cold springs it resembles *Spelerpes ruber*, with which it agrees also in color. The *S. longicaudus* is a terrestrial species.

The first specimens of *G. maculicaudus* were found by Mr. E. R. Quick, of Brookville, Indiana.—E. D. Cope.

An Apparently New Species of Chelys.—Only one species of Chelys has been known so far, the well-known fimbriated or bearded turtle, *Chelys fimbriata* Schneid. from South America.

The osteological department of Clark University received lately from Ward's Natural Science Establishment, among other reptiles, a specimen of Chelys in alcohol. The label gave the locality Orinoco. When I examined the animal I found considerable differences from the description and figures given in Boulenger's catalogue.

Boulenger gives as one of the *generic* characters of Chelys, "jaws In the specimen before me (length of shell over curve, 430 mm.; breadth over curve, 376 mm.) there is a very well-developed horny beak, not different in structure from that of other Chelonians. The structure of the skull also showed considerable differences with that figured by Boulenger. In Boulenger's figure the plates end in a sharp angle behind; this region is quite different in my specimen, and agrees exactly with the figure given by Cuvier (Ossem. foss.). But the greatest difference is to be seen in the lower face of the maxillary. In Boulenger's specimen the lower alveolar face of the maxillary at the middle is not broader than the vomer, forming about one-sixth of the breadth of the palate. My specimen agrees with Cuvier's figure; the alveolar surface is considerably broader than the vomer, and forms less than one-quarter of the breadth of the palate. The figure given by Hoffmann is like that of Cuvier. I do not know how the figures presented by Wagler and Bruehl compare with that of Boulenger, having the works of these authors not at hand. It is harely possible that the figure published by Boulenger is incorrect, since all the other new figures in the catilogue are accurate. I can only think that there are two different species of Chelys. The common *Chelys fimbriata*, figured by Cuvier and Hoffman, and agreeing with my specimen, with well-developed horny beak, and an other one figured by Boulenger as *Chelys fimbriata*, which would represent a new species, which may be called, if future examination proves its distinctness, *Chelys boulengerii*.—G. BAUR, *Clark University, Worcester, Mass., Oct. 30th, 1890.*

Snakes in Banana Bunches.—Editors AMERICAN NATURALIST: Referring to the item "Snakes in Banana Bunches," in the AMERICAN NATURALIST for August, 1890, I wish to say that nearly two years ago I obtained a snake, brought to this city in a bunch of bananas. It being in winter the snake was still alive, though lethargic, and which I identified as a young *Boa imperator*. It is about three feet in length, and is now in the museum of this Society.—J. A. HENSHALL, *Secretary and Director Cincinnati Soc. Nat. Hist., Cincinnati, September 8, 1890.*

NOTE BY EDITOR.—Since our item above referred to, two cases of the *Boa imperator* having been found in banana bunches, in Philadelphia, have come under my notice. It is a coincidence that since the banana is believed by some to have been the "forbidden fruit" of the Garden of Eden, serpents should be so readily concealed in its fruit.—E. D. COPE.

The Brain-Weight of Birds.—In preceding pages of the AMERICAN NATURALIST (see Vol. XXI., p. 389, and Vol. XXII., pp. 537–539) I have given my results attained by an investigation into the relative weight of the brain to the body in birds. As an addition to the ones already given I have made the following new relative weights:

Name of Bird.	Weight of Body.	Weight of Brain.	Sex.	Relative Weight of Brain to Body.	Date Specimen was taken.
Spizella monticola.	299	12¾	♂	1-23	Mar. 15, 1889.
Junco hyemalis.	310	12¾	♂	1-25	" "
" "	282½	11¾	♂	1-24	" "
Melospiza fasciata.	343	14	♂	1-25	" "
Troglodytes hiemalis.	145	9	♂	1-16	" "
Parus atricapillus.	184	11	♀	1-17	Mar. 23, 1890.
Sialia sialis.	628	15	♂	1-42	" "

The above weights are given in grains, and the specimens were taken at Chicago, Ill.—DR. JOSEPH L. HANCOCK.

Zoological News.—Vertebrata.—Sir William Turner has had an opportunity to study the placentation of dugong. He finds,[7] contrary to Harting, that the placenta is zonary, and probably is non-deciduate. His material was older than that of Harting.

J. S. Kellogg has studied the development of the primitive kidney of Amblystoma. In his preliminary paper[8] he finds that the pronephric duct is first to be formed, and, contrary to what has been described in other vertebrates, this arises not from the ectoderm, but from the somatic portion of the mesoderm. The tube is cut off from the rest of the cœlomic epithelium except at two points, where the connection persists as the nephratomes. With growth the funnels and their ducts become greatly convoluted.

[7] Proc. Roy. Socy. Edinburgh, XVI., p. 262.

[8] Johns Hopkins Univ. Circ., IX., p. 59. 1890.

ENTOMOLOGY.[1]

Entomology at Indianapolis.—The attendance of entomologists at the recent meeting of the A. A. A. S., while not as large as could be wished, was fully up to the average. We give below abstracts of a number of the papers read, while several others are reserved for future discussion. The first three following were presented before the Society for the Promotion of Agricultural Science, while the remainder were read before the Entomological Club of the A. A. A. S.

Insects Producing Silver-Top in Grass.—Professor Herbert Osborn, in an excellent paper, said the "silver-top" in grass is a whitening of the upper portion of the stalk, especially the head, which withers without maturing seed. Meromyza, Chlorops, and Thrips have been credited with being the cause of the mischief. Professor Comstock has shown that *Limothrips poaphagus* is often the cause. The injury may result from any attack upon the juicy base of the terminal node that cuts off the flow of sap to the head. Fully 90 per cent. of a large number of grass-stems examined contained no insects within the sheath. Many of them did show the punctures of Homoptera, especially Jassidæ, about the upper node, and it is probable that these leaf-hoppers are responsible for much of the "silver-top." These insects are open to general attack, and the injury should be prevented by their destruction.

Artificial Pasturage for Bees.—In a paper on this subject, Professor A. J. Cook reported experiments in planting Rocky Mountain Bee Plant (*Cleome integrifolia*), Chapman Honey Plant (*Echinops spherocephalus*), and a foreign mint (*Melissa sp.*). None of the experiments were successful, and the conclusion is reached that it is doubtful policy to sow any plant for its nectar alone. The best results will probably come in combining nectar secretion with some other useful quality.

Fertilizers as Insecticides.—In a paper entitled Fertilizers as Insecticides and Insecticides as Fertilizers, Prof. J. B. Smith reported the results of some interesting experiments. The author has lost all faith in "repellents." No matter how bad a smell may be created, if it does not act destructively as well, it is useless. All sorts of decaying or decomposing matter is attractive rather than offensive to insects. Barnyard manure has no repellent or insecticidal value. Phosphates

[1] Edited by Dr. C. M. Weed, Experiment Station, Columbus, O.

were used without success, but potash, in the form of muriate and kainit, has proved a valuable insecticide. In the proportion of one ounce to one pint of water muriate of potash destroys plant-lice, mealy bugs, bark-lice, and thousand-legged worms (Iulus,—called by the author of the paper "wire-worms," a misleading term). Kainit gave similar results. Hairy caterpillars, beetles, and bugs are not affected by these substances. Tobacco was also shown to be of decided value, both as an insecticide and a fertilizer.

Teaching Entomology.—Professor A. J. Cook, in his presidential address before the Entomological Club, discussed the methods of teaching entomology in use at the Michigan Agricultural College. All students are required to make drawings, and to dissect, rear, and collect insects. Reference collections are always within reach. The course of study should include botany, free-hand drawing, French, and German. The address was listened to with marked interest, and some admirable examples of drawing by Professor Cook's students were exhibited.

A Water-Lily Moth.—Professor D. S. Kellicott described the life-history of *Eustrotia caduca*. The larva feeds upon the fruit and leaves of *Nuphar advena*. The eggs are placed on the upper side of floating Nuphar leaves in irregular patches of a few in number. They are hemispherical y 1 mm. in diameter, and with a waxy hue; the surface is beset by about thirty meridianal, nodular ridges. The young escapes by cutting nearly off a round lid which it lifts on a hinge. The larvæ mature in July, and spin delicate white silken cocoons upon the leaves. The imagos begin to issue after a pupal period of eight days.

Oviposition of the Sagittaria Curculio.—Dr. C. M. Weed reported observations showing that the Sagittaria Curculio (*Listronotus latiusculus* Boh.) deposits its eggs, largely during July, in small bunches, usually of between five and ten, upon the leaf and flower stalks of Sagittaria. After being laid they are covered with minute particles of the epidermis of the stalk, chewed off by the parent beetle, and probably fastened together by some sticky secretion. Enough of these particles of epidermis are placed over the eggs to make a conical covering 1.5 mm. in diameter at the base, and 0.7 mm. high. When the larvæ hatch from the small yellowish-white eggs they bore directly into the stem, leaving the empty egg-shells and their protective covering still in place.

Oviposition of Dectes spinosus.—In describing the egg-laying habits of the Cerambycid beetle, *Dectes spinosus*, Dr. Weed said the

egg in a case observed was deposited obliquely in the pith of the stem of horse-weed (*Ambrosia trifida*). The outer fibres are first gnawed away to allow the insertion of the ovipositor. The egg is 2 mm. long by 0.3 mm. wide, elongate-oval, slightly curved, and pale yellow in color.

LIFE-HISTORY OF EVENING PRIMROSE CURCULIO.—The common borer of the evening primrose has been studied with some care by Dr. Weed, who reported finding a freshly-emerged adult *Tyloderma foveolatus* in an Oenothera stem, July 22, 1890. This was early, as the main brood develops during August and September. The beetle hibernates in the adult state, the sexes mating early in June. The full-grown larva is 8 mm. long by 2.5 mm. wide, the body, including the thin cervical shield, being white in color, while the head is light brown. The pupa is 7 mm. long, white, and of the normal curculionid form. Pupation takes place in the larval burrow within the stem. Besides *Oenothera biennis*, the insect develops in *Epilobium coloratum*. It is attacked by an external parasite, a species of Bracon.

LIFE-HISTORY OF LIXUS CONCAVUS.—Dr. Weed also reported rearing *Lixus concavus* in numbers from the stems of a common dock (*Rumex crispus*). The larva bores the stem and upper portion of the root, pupating about midsummer, and soon after emerging as a beetle. The larva is attacked by an external Braconid parasite.

OFFICERS ELECTED.—The following officers were elected by the Entomological Club for the ensuing year: President, Professor Herbert Osborn; Vice President, Miss Mary E. Murdfeldt; Secretary, Dr. C. M. Weed.

Crayon Drawing for Photo-Engraving.—The editor of this department has received so many queries concerning the methods and materials employed in preparing the drawings that have lately appeared in the Bulletin of the Ohio Experiment Station, and also in this department of the NATURALIST, that Miss Freda Detmers, by whom they were made, was requested to furnish a brief statement of the main points involved. She has kindly done so, with the following result: "The materials to be used are (1) ordinary bristol board or other stiff white paper; (2) a hard drawing pencil, a 5 H. Faber does very well; (3) a good quality of tracing paper, oiled on both sides; (4) a supply of different grades of the Ross special process stipple drawing paper; (5) Faber's black wax crayon pencils, No. 41; (6) a good black India drawing ink, such as Higgins's water-proof American India ink; (7) Gillott's lithographic crow-quill pens, No. 659. Having these materials,

the process of drawing is simple. My usual method is in the case of bisymmetrical insects to measure carefully with a pair of good dividers the length of the insect, transferring the measurements to a piece of paper, and drawing a straight line between the two end points. Then measure the length and breadth of every part of half of the insect, and locate these points on one side of the line. When the outline of half the insect is satisfactory, trace it, straight line included, on the transfer paper. Now reverse the transfer paper, placing the traced outline on the opposite side of the straight line, and rub over it with some hard point,—the point of a lead pencil, for instance. Remove the transfer paper, and the outline of the whole insect appears. This completed outline is then transferred by means of tracing paper to the special process stipple paper, and the drawing proper is made with the wax crayon. Pen and ink is used occasionally to indicate fine hairs, etc. Many beginners make outlines in ink, where simple crayon outlines would be better. It is important to keep the black and white points distinct, not blending them by rubbing."

To this it may be added that all drawings should be reduced about one-third or one-fourth, *i. e.*, to two-thirds or three-fourths the size of the drawing. The engraving should be done by a good establishment. It does not pay to have the cheap processes of zinc-etching, etc., tried on good drawings. Many engraving establishments return soft metal cuts, in which case they should be saved as originals and electrotypes made from them.—C. M. W.

PSYCHOLOGY.

Jastrow on a Writing Test.—In a paper entitled "A Study in Mental Statistics," Prof. Jastrow describes the results of a mental test in which fifty students of a class in psychology, at the University of Wisconsin (twenty-five men and twenty-five women), took part. The task consisted in writing 100 words as rapidly as possible. The material thus collected was utilized to shed light upon (1) the similarity of our ideas and habits of thought, (2) the links that bind our ideas together, and (3) the time required for these processes.

(1) The general tendency to regard one's mental habits and products as singular and original, and consequently to look upon every evidence of similarity of thought as a strange coincidence, receives a set-back from the result of the present and similar studies, for it is found that

these fifty persons, independently writing one hundred words from the many thousand with which they are acquainted, all in all, select from the same 2,024; *i.e.*, of the five thousand words written only 2,024 are different. Again, 1266 words occur but once in the aggregate lists, and omitting these we find that about three thousand of the words are formed by the repetition of only 758 words. Passing to an analysis of this "mental community," it becomes clear that it is greatest at the beginning of the list, and becomes less towards the end; *i.e.*, the habit is to write first the most common, and when these are exhausted, the more unusual words. A very interesting point is the comparison of men and women in their tendency to repeat one another's thoughts. The evidence is unmistakable that the lists of words drawn up by the women are much more like one another than are those written by the men. The women use only 1,123 different words, the men 1,376; the women write but 520 words that occur but once in the lists, the men write 746 such words.

(2) A study of the processes involved in these lists bases itself upon a careful analysis of the ideas therein represented. The relative sizes of such classes, in a measure, indicate the prominence of different classes of objects in the minds of the writers. It may be interesting to mention that the five best represented classes (of the twenty-five adopted in the paper) are "Names of Animals," "Articles of Dress," "Proper Names," "Actions," "Implements and Utensils." The sexes present characteristic preferences for the various classes. The women contribute most largely to "Articles of Dress," writing 224 such words, while the men write but 129; they show an equal favoritism for "Articles of Food," writing 179 such words to but 53 for the men. The men, on the other hand, show fondness for "Implements and Utensils," "Names of Animals," "Professions," "Abstract Terms," etc.

Of the various links by which the one word suggests its successor, it may suffice to indicate as prominent types, (*a*) association by sound, in which words are rhymed, or begin with the same letter; (*b*) by belonging to the same class, as when a series of animals or articles of dress is formed; and (*c*) by more general but not briefly describable relations. One may combine the two inquiries (1) and (2) to ask how often the same word is associated with the same word in different lists. If we take the twenty words most frequently occurring, we find over 500 mentions; and if we examine in each case the word preceding the given word we find it to be the same in 111 cases, and the succeeding word the same in 145 cases,—certainly a remarkable

result. Here, again, the women are found to repeat one another more than the men.

(3) Regarding the time occupied in the process the result reached is that (roughly speaking) it takes on the average 308 seconds to write such a list of 100 words; that 210 seconds are consumed in the mere act of writing, 114 seconds in thinking of what to write, and 16 seconds in which both may be done.

These results are offered, in addition to whatever value they may possess, as an illustration of how, by simple experimental methods, we may become more intimate with the processes that we constantly but unconsciously perform.

ANTHROPOLOGY AND PREHISTORIC ARCHÆOLOGY.[1]

Anthropology of the American Association for the Advancement of Science, at Indianapolis.—The American Association for the Advancement of Science held its thirty-ninth meeting at Indianapolis, Indiana, beginning on Tuesday, August 19th, 1890, and continuing ten days. The meetings were held in the new State House, where were also the offices of the Local Committee and Permanent Secretary. This meeting was the fiftieth anniversary of the organization of the Association of Geologists and Naturalists, the parent of the A. A. A. S., which added greatly to its interest. Indianapolis, with its wide, well-shaded streets, its large, comfortable hotels, and the unusual accommodations afforded by which all the sections could meet in large halls under one roof, made this the most important meeting ever held in the West. The Local Committee are to be commended for their admirable arrangements for the comfort of the large number of members and their friends.

The department of Anthropology held its meetings in the Hall of Representatives, with Dr. Frank Baker, of Washington, D. C., as president, and Prof. Joseph Jastrow, of the University of Wisconsin, as secretary.

The address of the President of the Section was listened to with much attention, and created much interest. Dr. Baker is professor in the Medical College of the Georgetown University, lecturing on human anatomy, and is well qualified to speak as he did upon the "Ascent of Man." His arguments were in favor of the theory of

[1] This section is edited by Dr. Thomas Wilson, of the U. S. National Museum.

evolution of the species, and his facts were derived from the changes wrought in the anatomical structure of man. The theory was that those elements or peculiarities of the bones and muscles of man which by reason of his changed condition from brute to man, from quadruped to biped, were not used, have largely disappeared, and nothing is now found but the vestiges, while those which in the changed condition were more used grew and strengthened and became the new elements as we find them, but showing signs of their recent origin. He said, comparing the human hand with that of the anthropoids, its greater efficiency has been produced in two ways: first, increasing the mobility of the thumb and fingers; second, reducing the muscles used to assist prolonged grasps, they being no longer necessary. The latest elements ought to show signs of their recent origin, while those going out of use ought to have become vestigial. Of the former are the flexor muscles of the thumb and fingers; of the latter is the *palmaris longus*, used for climbing and grasping. These differences are more clearly manifested in the negro than in the white race. So also the change in the obliquity of the elbow-joint and the axis of the humerus, that the hand can be easier carried to the mouth. This is marked in the white race when compared with the negro, and still more when compared with the anthropoids.

The scapular index is highest in the white races, less in the infant, the negro, the Australians, and still less in anthropoids.

The *epitrachleo-anconeuo*, a small muscle at the elbow-joint, is used in apes to effect a lateral movement of the ulna upon the humerus, but in the white race this lateral motion has been lost, and the muscle has degenerated. A perforation of the olecranon fossa may be regarded as a reversion towards the anthropoids. The doctor continued these illustrations, citing the shoulder-blade, the foot, the great toe, the muscles needed for the erect position of man, the head, the spinal column, the pelvis, the bladder, the liver. The valves of the veins are arranged for a quadrupedal position. Evidently intended to resist the action of gravity, they should, to be effective, be found in the large vertical trunks. But in the most important of these they are wanting. Yet they occur in several horizontal trunks, where they are, as far as we know, of no use whatever. Place man on all fours, however, and it is seen that the entire system of valves is arranged with reference to the action of gravity in that position. The great vessels along the spine and the portal system, being then approximately horizontal, do not require valves; while all the vertical trunks of considerable size, even the intercostal and jugular veins, are provided with

them. A confirmation of this view is found in the fact that the valves are variable in character, and tend to disappear in the veins where they are no longer needed. He concludes, upon surveying the whole field, that this indicates a derivation of the vertebrates from some form of the annelid worms, among which a single unit produces by successive budding a compound longitudinal body. This view is fully confirmed by the behavior of the human embryo. In the spinal column of the human embryo thirty-eight segments can at one time be made out. Four or five of these generally disappear, but cases are by no means wanting in which they remain until after birth, and constitute a well-marked free tail. In one case, carefully examined and described by Lissner, a girl of twelve years had an appendage of this character 12.5 centimetres long. Other observers, probably less careful and exact, report much greater lengths. From some observations it would appear that abnormities of this kind may be transmitted from parent to offspring. Dr. Max Bartels recently collected from widely-scattered literature reports of 116 actually observed and described cases of tailed men. In 35 instances authors report such abnormities to be possessed by an entire people, they themselves having observed certain individuals. These cases are scattered throughout the whole of the known globe, and extend back for a thousand years.

At first man's skull seems to be much simpler than the typical form. The bones are fewer and less complicated. But follow back the course of development, and we find the bones separating,—the frontal into two pieces, the occipital and temporal each into four, the sphenoid into eight, repeating what we find as we descend the vertebrate scale. The capacity of the cranium is usually held to distinguish man, yet the lowest microcephali approach to the apes in this respect, and the lower races have unquestionably smaller brains than the higher. As far as can be judged, there has also been an increase in average capacity during historic times.

"The Indian Origin of Maple Sugar," by Mr. Henry W. Henshaw, of Washington.—The point was as to whether the Indians learned to make sugar of the whites or vice versa. The argument drawn from the maple-tree festivals and linguistic evidence showed the red men were in no way indebted to the whites for sugar, no more than for the cultivation of corn, the pumpkin, bean, and tobacco. Their simple process was aboriginal, resulting from their own observation and inventive powers. They collect the sap in birch-bark vessels. These hold in some cases a hundred gallons. They take advantage of cold April nights to freeze the sap, and in the morning throw out the ice.

They evaporate it by throwing hot stones into the reservoirs of sap. The sugar is eaten mixed with corn. Sometimes the pure sugar is their only diet for a month. They boil venison and rabbits in the hot sap as they evaporate it. They also make sugar from the silver maple and box elder. That the Indians made sugar from times unknown is proved by their language, their festivals, and their traditions. Several authors of early times, telling af their visits to the Indians, mention maple sugar, and one of them, in 1756, describes the Indian's mode of preparing it. The gathering of sap and making of sugar formed one of their annual religious ceremonies.

"Fort Ancient, Ohio," by MR. Warren K. Moorehead.—Mr. Moorehead spent two summers in excavating the mounds and studying the topography of Fort Ancient, on the Miami River. He has shown as much energy in digging out Fort Ancient as Schliemann in excavating Troy. As an indirect result of his labors, the Legislature of Ohio authorized the purchase of the fort and surrounding ground as a State park. A map of Fort Ancient, together with a short notice of Mr. Moorehead's work, was published in the AMERICAN NATURALIST, April, 1890, p. 383. His book on that subject, just published, which has already passed its second edition, gives a complete account of this great prehistoric earthwork.

The fort is really two, the old fort and the new fort, connected as by an isthmus. Each fort has about an acre and a-half of ground, and the two resemble in general shape North and South America, with their connecting isthmus. The cemeteries, from which over two hundred skeletons have been removed and measured, reveal two classes of people, two kinds of implements, and two varieties of pottery, plain and ornamental. The village seems to have been occupied for three periods, and each period of occupancy lasted for many years. Four feet below the present surface there are occasionally a bed of ashes or a mass of burnt rock, around which and in which occur large numbers of perforated mussel shells, bone awls, shells of the land tortoise, pottery fragments, flint chips, hammer stones, etc. Then there are about two feet of earth, which may have been deposited in a freshet, or slowly accumulated during a period of one hundred or more years that the ground was unoccupied. Following this is a second layer, heavier, while the third or upper stratum is but one foot from the present surface.

The preservation of minute bones, fragile shells, and perishable objects is due to the ashes, of which there were many bushels.

There is a spot in a field within a half a mile of the new fort,

situated upon the plain where it commands a view of the enclosure, upon which were manufactured arrow-heads of quartz. Quartz is not frequent in Ohio, and we have never found it except in isolated specimens; its presence indicates that a distant tribe was present when these chippings were deposited.

On the village site in the old fort, and upon that near the Little Miami River, we found thousands and thousands of pottery fragments, some of them decorated in a similar manner to those at Madisonville. In the bottom of the ditches outside the fort, and in the fields bordering the fort upon the east side, we find a class of pottery sherds different from those found within the structure. I have upwards of five thousand specimens of pottery of both varieties. Years might be spent at Fort Ancient in excavation of the graves and cemeteries that nearly everywhere are to be found beneath the towering oaks and beeches, and yet there would remain sufficient material to engage the attention of archæologists for a long time to come. Questions all unsolved present themselves at every step. For instance, the age of Fort Ancient,—was it constructed all at one time or in epochs? The races of people who constructed it,—who and what were they? The civilization and social surroundings which required such a work, the terraces, the ravines, the timber in the walls, the gateways, the huts, the mounds, cemeteries, etc.

This great enclosure, so rich in facts, so productive of implements that tell us of the every-day life of the ancient people who lived within its walls, may yet reveal to the patient investigator its history, and dispel the darkness that surrounds the origin and movements of ancient men upon the American continent. It is to be hoped that every aboriginal structure in the United States will become the property of the Government, or of some institution which can preserve, explore, and beautify it.

Mr. W. H. Holmes, of the Bureau of Ethnology, Washington, D. C., read a paper on the "Aboriginal Stone Implements of the Potomac Valley." He has lately investigated the steatite quarries around Washington, and found the aboriginal vessels in their rudest stages of manufacture, also the implements with which they had been made.

He described his work among the quartzite bowlders on Piney Branch, near Washington. The impression of Mr. Holmes's paper, and the discussion following it, is thus told in one of the Indianapolis journals of the day:

"Hence the rude forms of chipped stones are not tools at all, as has been taught by archæologists for half a century, and so the 'rough

stone age' and the 'smooth stone age' of the District of Columbia and all the rest of the world are knocked into smithereens. This is not Prof. Holmes's exact language, but that is just what he meant.

"Professor Holmes will pick a few bushels of flint bowlders out of Pogue's run, and by knocking one against the other can in a few hours leave evidences of the poor old 'Paleolithic man' scattered all over the capitol grounds. By finishing up his flint stones into good shape —arrow-heads, knives, skinners, etc.—he can prove that the Old Paleolith was followed by the Indian races. This knocks some dear old theories in the head, and particularly sets the French archæologists in the background.

"Professor Putnam, who knows all about it, observed exactly the same thing along the shores of Cape Cod several months before, and says the French have played the deuce with this ancient and honorable science, and that their 'effort to classify our ancestors on the form of their stone implements is no better than the matching of brass buttons.' 'Primitive man,' said Professor Putnam, 'made only a cutting-edge on the bowlders. The Indian went further and made knives and perforators, and that is all there is of it. The many divisions based on the shape of the implements is artificial and of no value.'

"Dr. Mason, the creator of the National Museum, did not like to see the 'French archæologists given such a black eye by Prof. Putnam,' but he placed a high value on the views of Mr. Holmes, which are accepted in this country almost universally. Mr. Holmes can make Indian arrows out of a beer-bottle, a piece of cannel coal, or anything that has a shell-like fracture. All he uses is a piece of hide to protect the hand, and a piece of deer antler or an iron nail to press off the flakes of flint. He can give pointers to Hiawatha's ancient arrow-maker, as he is not limited to jasper and chalcedony, but can shape them deftly out of almost anything except punk and dried pumpkin."

"The Brains of a Man and a Chimpanzee Compared," by Prof. Burt G. Wilder, of Cornell University.—Four large diagrams were displayed for the comparison. The fissures and contortions of the two brains were shown and commented upon, and the paper stated that the resemblances were numerous and impressive. "Indeed, if one were to look simply at the middle aspect of the two brains only, it would hardly be safe to affirm that one organism is the habitation of an immortal soul and the other one of the 'beasts that perish;' that the one was made only a little lower than the angels, and the other only a little higher than the monkeys."

Prof. Cope continued the comparison of the human brain and the chimpanzee's brain, being especially struck with the smoothness of the great convolutions in the brains of the lower types of men, in which they resemble the other mammalia. These, he said, are characters that cannot be remedied in any brief space of time,—perhaps cannot be remedied at all. These differences in the brain involve social and political questions.

"The brain structure we find in Indo-European races has required centuries to develop. We are now confronted in this country with the mixture of two races,—an inferior race which has never done anything with a superior race of later origin. The question is, Are we going to permit it? I believe we should follow the law of self-preservation, and should oppose and resist hybridization. We have before us a problem of race depreciation, and statesmen and reformers should study the question as Professor Wilder has studied it."

Dr. J. A. Houser, of Indianapolis, continued the discussion, saying that "the American people need have no fear of a race whose front brain lacks fifteen cubic inches of brain stuff as compared with the average. The superior cerebral convolutions of the brain have made the laws and governed the world. In all kindness and charity, the higher intellect should stoop down and say, 'I will help you, but you shall not control me.'"

The discussion continued into the next paper, which was by Mr. J. Muller: "The Peculiar Effects of One-Sided Occupations on the Anatamy and Physiology." Prof. Cope said: "The subdivisions of the higher races of men based upon the features of the face are of little value; in the lower races the divisions based on such peculiarities are more constant. Deep-seated anatomical characters are not easily altered by occupations; only superficial characters are so altered. A man with a flat shin bone is nearer the ape in relationship than a man with a triangular shin bone. A man with a tritubercular teeth is in that degree further from the ape. The shin bone, the tubercles, and the hyoid bone have characters which are not soon eradicated, and whose significance must not be forgotten. The tendency of the two last bones of the little toe to unite is a sign of advancement. The little toe is, in short, going out of existence. The man whose little toe-joints are anchylosed is a further remove from the ape. In the Hottentot, on the contrary, we have anchylosis of the bones of the nose, relating him to the lower primates. The science of paleontology comes in play here and gives us aid. These characters, like the flat shin bone and the smooth brow, are not easily overcome. They are deep-seated. We

should exert ourselves to get rid of them, but not so fast as to depreciate the higher races."

The bearing of Prof. Cope's remarks was that important natural differences in races should have their weight in social life and politics.

Prof. Jastrow, of the University of Wisconsin, called attention to the distinction between characteristics relating to functions and activities during life and those observed upon the body after death. While the former may be very important and easily noticed in every-day life, the latter are those most in use by anthropologists for race distinctions. The former are modified in a relatively short period; the latter are relatively fixed, and are modified with extreme difficulty. The former are physiological, the latter anatomical; and it may be said that it takes a long time for physiology to be converted into anatomy.

Prof. O. T. Mason, of the Smithsonian Institution, read a paper on "The Arts of Modern Savages as a Means of Interpreting Archæology." He cited the walrus and other animals engraved on horn and ivory by the Esquimaux. A century ago they engraved with flint points; now they have steel knives, and their work is much superior to its former state. The art capacity of the people has not improved; the tool has improved. Such work must not be cited to a wrong purpose. By studying the work of present savage races under the varying conditions of contact with civilized races, much light may be thrown upon the development of races. "There is an apparent millennium among the archæologists here to-day," said Professor Mason; "we are holding an apparent love-feast, but we really represent two hostile camps. Some of us believe the tools found and the mounds and forts all over the great West were made by Indians. There are others here who believe these great works, built without the use of iron, were made by a people of another race,—the mound-builders, whom the Indians have followed. Much light may be thrown on this subject in the next five years. How shall we understand and interpret the tools, the dress, the habits, the houses, the laws, the social life, the religion, the folk-lore, of these ancient American peoples, whether they are Indians or mound-builders? That is for us to do, and the humblest may do their part. Collect all the facts, and the truth will at some time be interpreted."

Who were the Indians and the mound-builders? Has America been peopled by three different races,—mound-builders, Indians, and Caucasians,—driving off each other in succession? Or were the Indians and the mound-builders one and the same people? These are the questions which are considered by American archæologists of to-day.

Prof. Putnam, of Harvard, said regarding the "two hostile camps": "For my part, I do not regard either Indians or mound-builders as scientific names. The word Indian was a misnomer, as we all know, —an error not of the early navigators but of Columbus, who mistook the West Indies for the East Indies, and called the people Indians, a word now used for the aboriginal people of every country; even Australian Indians are spoken of. For my part, I believe the early inhabitants of America were of several stocks. I like the word 'stock' in this connection. There was a short and round-headed southwestern stock, as the Zuñis; there was a long-headed northwestern stock; also the Eskimo of the Arctic regions, and the Caribs of the West Indies. Of course these graded into each other and mixed, but the central types are distinct. These various peoples of the past comprised the so-called mound-builders and Indians. These are my views, and I do not stand entirely alone. The Harvard camp and the Washington camp have no other desire than to find the truth."

Prof. Putnam gave an elaborate description of his discovery of "A Singular Earthwork Near Foster's Station, in the Little Miami Valley," about twenty miles north of Cincinnati. Prof. Putnam was assisted by Dr. Hilborn T. Cresson, Messrs. G. A. Dorsey, M. H. Seville, and Ernest Volk, all of the Peabody Museum. A series of drawings and photographs were used in illustration. Prof. Putnam had also several bushels of cinders, burnt limestone, charcoal, and ashes dug from the earthwork. "This mound," said the professor, "is in the angle of a creek and the river. It is a flat-topped, circular hill, about one-half mile round at the rim,—such a hill as is frequently found at the intersection of a creek and river. It is made by the river and creek washing away the drift material on either side. Such hills command the valleys as lookouts, and are often fortified. Around the brow of this hill is a ridge in some parts; at others it is not elevated above the surface. This ridge is made up of well-burnt clay, and includes masses of burnt limestone, clinkers, charred logs, and heaps of ashes, from a bushel to forty bushels in bulk. This strange circular rim is over half a mile long, twenty to fifty feet wide, and eight to ten feet deep. To have burnt all this clay must have required a heat like that of a Bessemer furnace. Another strange feature is that the rim of burnt stuff is backed by an escarpment of well-laid stone wall, to keep the burnt material in place. This stone wall probably extended down to the water, but the creek has worn its way down and away from the wall. We have cut through the burnt wall in several places, and shall penetrate it in others. No bones and but a few pieces of pottery have

been found. The fires could not have been those of charcoal pits, nor was it a lime-kiln. There must have been an immense amount of fuel collected to burn this mass of clay and stone." The theory of cremation was discussed, but if these are crematories it is quite remarkable that no bones or remnants are found.

MICROSCOPY.[1]

Demonstration of the Chromosomes.[2]—In the preparation of the egg for tracing the history of the nuclear elements, Boveri employed two methods. In one, the preservative fluid was a mixture of picric and acetic acid, and the staining fluid borax-carmine; in the other, which was the principal reliance, Schneider's acid-carmine served both as a preservative and staining medium. The living egg is followed under the microscope until the desired stage is reached; then a drop of acid-carmine is added at one side of the cover-glass, and drawn under by the aid of a bit of filter-paper applied at the opposite side. After 5-30 minutes the fluid is replaced by glacial acetic acid, which decolorizes all parts of the egg except the chromosomes, and at the same time renders the cytoplasm quite clear, while giving a sharp definition to the chromatic elements. The achromatic elements are not well preserved.

The egg so prepared is mounted in glycerine. In order to determine the exact number of chromosomes it was often found necessary to press the egg more or less, and thus separate the chromosomes a little. These preparations last for only a few days.

Caryokinetic Figures.[3]—Dr. Solger calls attention to the fact that the amnion of the rat is more convenient material for exhibiting the caryokinetic figures than the mesentery of the young rabbit (recommended by Orth in his "Cursus der Normalen Histologie"). The advantage of such material is that it can be prepared without the necessity of imbedding and cutting.

The freshly-excised uterus horn is placed in *a saturated aqueous solution of picrid acid*, and then the egg-membranes—at least the chorion—is cut open with scissors. The amnion (of embryos 1.8 cm. long to 2 cm. long) then floats as a very thin membrane, or as a closed sac still envelops the embryo.

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2] Boveri. Jen. Zeitschr. XXIV., 2 and 3, 1890, p. 319.

[3] B. Solger. Arch. f. mik. Anat., XXXIII., 4, p. 517, 1889.

After 24 hours the preparation is washed and placed in 70 per cent. alcohol, which is then gradually replaced by a higher grade. For staining, Ehrlich's acid hæmatoxylin, diluted with half its volume of water, is used for five minutes.

Flemming's fluid, followed by saffranin, also gives excellent preparations.

Direct Division of the Nucleus.[4] — Platner avows his conviction that the nucleus does divide, in some cases at least, without any caryokinetic phenomena. This fact, according to Platner, is clearly shown in *malpighian tubes* of insects (e.g., Dytiscus). The gland-cells are very large, and their nuclei are often three or more times the diameter of the nuclei in Triton cells. The tubular organs can be examined in toto without the trouble of imbedding and cutting.

Kleinenberg's picro-sulphuric acid is recommended for hardening, and borax-carmine for staining.

Spermatogenesis in the Hermaphrodite Gland of Limax agrestis.[5]—Platner recommends the following method of preparation for the reproductive elements in Limax:

The fresh hermaphrodite gland is placed in the stronger Flemming's fluid for one hour; then three to four times its volume of water is added to the fluid, and the object left 24 hours. The preparation is then washed in the manner described by Flemming, and passed through ascending grades of alcohol.

The following hæmatoxylin solution gives the best stain for the neben-nucleus:

Hæmatoxylin	1 g.
Alcohol absol.	70 g.
Aq. dest.	30 g.

To be kept in a dark bottle.

The object is stained in toto 24 hours; then decolorized in a 1% alcoholic solution of bichromate of potash. For this purpose a solution of 10 parts of bichromate of potash in 300 parts aq. dest. is kept on hand, from which 30 ccm. may be taken each time for use, and mixed with 70 ccm. 95 per cent. alcohol. The fluid should be kept in the dark during the process of decolorizing, which may require from 12 to 24 hours.

The object is next placed in 70 per cent. alcohol, and kept dark for one or more days. Then follows absolute alcohol, cedar oil, and imbedding in paraffine.

[4] Platner. Arch. f. mik. Anat. XXXIII., 1, 1889, p. 145.
[5] Platner. Arch. f. mik. Anat. XXXIII., 1, 1889, p. 126-7.

Conjugation in the Infusoria.[6]—Lack of material has hitherto been the chief difficulty in the way of thorough study of the phenomena of conjugation. Investigators like Balbiani, Stein, and Bütschli have complained of the rarity of this state, and have explained their incomplete and fragmentary observations on this ground. The subject itself is extremely complex, and requires, as a first condition of successful study, most abundant material.

Thanks to Maupas, we now know how to supply this need. Take stagnant water containing algæ, confervæ, debris of dead leaves, and other vegetable matter, and keep it in dishes covered with glass plates, to prevent evaporation and to guard against dust, until putrid fermentation sets in. Infusoria contained in this water, finding abundant nourishment, multiply in great numbers. When they become abundant they may be taken up in a drop of water and kept on slides in damp chambers, as before described.[7] The infusoria continue to multiply until the supply of food fails; *hunger then leads them to conjugate.*

When rare species are desired, which do not multiply rapidly in small aquaria, two individuals from different sources may be isolated, and made to multiply on slides kept in damp chambers. Mixture of specimens from the two slides, when the food-supply is exhausted, usually results in conjugations.

The isolation of groups of infusoria on slides offers still another important advantage: it enables one to examine them easily with the microscope, and thus to catch the first conjugations.

Maupas calls attention to the fact that, as a general rule, conjugation is most frequent towards the end of night and during the early morning hours.

In beginning the study of a new species the first thing to determine is the duration of the period of conjugation. This point ascertained will serve to guide the course of investigation. The isolation of couples in conjugation is indispensable to the study of the phenomena following separation.

For killing isolated couples at successive hours, in order to trace the history of the nuclei, Maupas recommends corrosive sublimate (1 : 100) as the best reagent. He proceeds as follows: The infusoria are taken up with a pipette and placed in a drop of water on a slide. Fine hairs, suited in thickness to the species under study, are then placed on either side of the drop, as supports for the cover-glass. The in-

[6] Maupas. Arch. de Zool. exp. et gén., 1889, No. 2, p. 168.

[7] NATURALIST, April, 1889.

fusoria should be somewhat compressed, but not crushed. The cover-glass is then placed, and the sublimate added as quickly as possible at one side, and sucked under by the aid of a bit of blotting paper at the other side, care being taken not to disturb the cover. After fixation, the preparations are stained with methyl green in two per cent acetic acid, and then mounted in glycerine. In some species it is best to omit staining altogether, as the stain obscures the micronuclear elements.

It is perfectly useless to undertake the study of conjugation without a powerful homogenous immersion objective.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Association for the Advancement of Science, of 1890.—The committee of the A. A. A. S. *on* the International Congress of Geologists has been discharged by a vote of the association at its recent meeting in Indianapolis. It is unnecessary now to inquire into the motives which induced a small number of persons to cause this act to be accomplished by the body of the association which was ignorant of the true facts, or to scrutinize the means employed by the party of destruction; further than to say that neither the president nor secretary, nor (it is believed) the majority of the members of that committee, asked or desired such discharge. In a letter written by Professor Hall, the president, to Dr. Frazer, the secretary, before the meeting, a copy of which was sent to Prof. Stevenson, he says: "I had no personal or ulterior purpose in keeping the committee in existence last year. I believe that several of us considered it better to do so at that time,—and certainly we were not then prepared to say our work is finished, nor are we prepared to say that now. * * * *If the majority of the members agree to it*, I see no objection to *making our final report and asking to be discharged.* I do not think it courteous or becoming in gentlemen of the council of the A. A. A. S. to move the abolition of the committee, and especially men who are not geologists," etc., etc.

Upon learning, after the meeting, that it was reported there that he had authorized his signature to be attached to a paper asking for the discharge of the said committee, Prof. Hall wrote: "I have never signed nor authorized any one to sign for me any paper whatever, except to you [the secretary] and for your report. I sent a copy of my letter to you * * * to Professor Stevenson, and wrote him giving my rea-

sons *why there should be a final report before disbanding.* I am writing now only to say that no one except yourself has had any authority to sign my name to any paper of any kind whatever."

The present state of things suggests an inquiry into the American committee "*of*" and "*on*" the International Congress of Geologists.

In tracing out the history of a body like the American committee it is essential to bear in mind that the conditions which accompanied its birth in the A. A. A. S. are not those under which a formal deliberative body gestates and nourishes its offspring.

If such a body be on the point of doing some inconsistent act, it has usually many sons skilled in precedent, parliamentary rule, and the history of the particular case to restrain it. The executive acts of the American Association for the Advancement of Science are generally crowded into a short time, and must be settled by a large and heterogeneous crowd of persons, many of whom understand but vaguely what is proposed or why it is proposed. It must also be admitted that the multifarious duties of the permanent secretary, and his invariable condition of overwork during meetings render it impossible for him to guide the actions of the large organization, with its many motions relating to minute details of its work, clear of inconsistencies.

The general secretary is changed annually, and the incoming officer rarely if ever can keep track of the business of the last year, still less of two or three years back, without which intelligent action is impossible.

The result of this is inevitable confusion and inaccuracy in the printed records of the association, abundantly illustrated in the history of this committee, as I have to some extent pointed out in the preface to the reports for the London session.

What has happened with regard to this committee is as follows:

At the Buffalo meeting of the A. A. A. S., held in 1876, a committee was appointed "to consider the propriety of holding an International Congress of Geologists at Paris during the International Exhibition of 1878."

This committee, consisting of W. B. Rogers, James Hall, J. S. Newberry, T. S. Hunt, C. H. Hitchcock, and R. Pumpelly, elected Prof. Hall, chairman, Dr. Hunt, secretary; added to its number Prof. Huxley, Dr. Otto Torrell, and Dr. E. S. Van Baumhauer; not only considered but decided upon the propriety of having such a congress, and went straight ahead to secure it.

This committee, in reporting at the Nashville meeting, calls itself "a committee to arrange for an International Geological Exhibition

and Congress," and gives in detail the plan which it sketched, and which was afterwards followed by the Paris committee of organization. A somewhat humorous feature was the adoption of the following extraordinary resolution on recommendation of the standing committee of the association.

"Resolved, that in addition to the names of Prof. A. C. Ramsey, Director of the Geological Survey of Great Britain, already added to the International Committee, the president for the time being of the geological surveys of France, London, Edinburgh, Dublin, Berlin, Belgium, Italy, Spain, Portugal, and of the Imperial Institute of Vienna be requested to form part of our commission." That is, from the American Association point of view, these persons, although they were not members of the American Association, were asked to take part in the inquiry into the propriety of holding an International Geological Congress, for which the preparations were a long way towards completion, which was to be held, and actually was held, during the next year.

The A. A. A. S. was never asked further to sanction a congress; but in 1877 Prof. Ramsey and most of the foreigners above were added to the committee "by the standing committee."

The opening pages of the Paris volume show how this committee was looked upon there. It is said: "At the termination of the World's Fair of Philadelphia, in 1876, there was formed at Buffalo a committee for the organization of an International Geological Congress at Paris in 1878." Not a word is said of the American Association, but the names of the committee above immediately follow under the heading of the "comité fondateur." This comité, it is said, appealed to the Geological Society of France, which in turn called upon its council to constitute a committee of organization.

The council responded by naming thirty-three Parisian savants. The first act of this committee of organization was to declare that provisionally the following should be deemed a part of the council of the congress:

1st. The members of the comité fondateur.

2d. The members of the committee of organization.

3d. The members of the congress who were actual presidents of French or foreign geological societies and directors of large geological surveys.

In the opening address of the president, M. Hébert (Paris volume, p. 24), he thus alludes to the initiation of the congress: "The initiation of this congress, you are aware, is not due to France. Certain

authoritative voices have been raised to proclaim the necessity of one, but it is to our eminent colleagues assembled in Philadelphia, in 1876, that all the credit is due."

M. Jannettaz, the general secretary, who followed the president, remarked: "It is in Buffalo, as the president has just told us, at the end of the exposition of Philadelphia, that the savants of diverse nationalities, and of a large representation in the history of modern geology, agreed to institute the first International Geological Congress; they were of the unanimous opinion that the congress could be held in Paris during the continuance of the Exposition Universelle. They created in consequence a committee, to which we in France have given the name of the 'comité fondateur,' to recall at once its initiative, and the noble American city which was its point of departure" (Paris volume, 26, 27).

Here, then, was the congress fully started, with no further impulse than the appointment of a committee by the A. A. A. S. for the innocent purpose of "considering the propriety" of holding one. No wonder that the congress regarded the concourse of scientific men in Buffalo as its parent, and never once alluded to the American Association; for the latter had never declared whether it considered the holding of a congress proper or not.

M. Jannettaz goes on to say that the secretary of the comité fondateur, Dr. T. Sterry Hunt, requested M. Tournouër to take the measures which he should judge advisable for the success of the idea.

When the committee of organization was constituted it studied carefully the plan presented to it by the comité fondateur, and issued circulars to carry out the latter's wishes as much as possible.

M. Jannettaz asserts that the programme of this session of the congress was simply an enlargement of the plans of the comité fondateur.

At the Saratoga meeting of the American Association, in 1879, Prof. Hall gave a sketch of the proceedings of the Paris session, and "recommended that the committee be continued." At the same time Dr. Hunt recommended that the foreign members who had been added (Van Baumhauer, Huxley, and Torrell) be released from service on the American committee.

The A. A. A. S. voted both of these propositions.

It seems clear that there is here a confusion between more than one committee, composed of the same persons, it is true, but exercising entirely different functions, and existing by virtue of totally distinct appointments. First, the A. A. A. S. appointed a committee to investigate the propriety of a congress.

This committee, instead of investigating the propriety, and without making any report on the subject of the propriety, actually created and set into operation the congress; which in turn, after being organized, proclaimed the committee's members the "comité fondateur," and one of the constituent parts of the congress's council. With this act the A. A. A. S. had nothing to do, and could neither add to nor take from the comité fondateur its function thus recognized. The only question is whether the congress chose to apply the advantages pertaining to membership in this committee to the original persons who comprised the comité fondateur, or preferred to admit to these privileges all who were named from time to time on the "propriety" committee by the American Association.

The congress's decision on this point is seen in the action which it took during the Bologna session; but in the meantime there is no doubt that as long as the congress does not rescind its act, there exists an integral—the first-named—part of its council, called the comité fondateur, which at this time coincides with the present membership of the American committee.

President Capellini, the editor of the proceedings of the Bologna meeting, opens that splendid volume with a somewhat more accurate statement of the origin of the congress than that given by President Hébert or General Secretary Jannettaz, which he rightly attributes to a motion made in the A. A. A. S., and states the facts virtually as they have been given above. (Bologna Volume, pp. 3, 4, and 5).

But it must not be imagined that because Prof. Capellini inserted into his account of the history of the congress the motion before the A. A. A. S. that he interpreted it differently from MM. Hébert and Jannettaz in the Paris Congress. This is his understanding of the case, given in his presidential address: "At the termination of the World's Fair in Philadelphia a group of geologists assembled in Buffalo constituted a committee for the organization of an international geological congress at Paris in 1878

"The committee created in America took the name of the 'Comité Fondateur de Philadelphie,' to recall its initiative and the exposition which had been the occasion of it."

Again, the committee of organization adopted the following (Art. 5): "The council shall be composed (1) of the members of the comité fondateur; (2) of the members of the committee of organization; (3) of the members of the bureau of the congress; (4) of the actual presidents of geological societies and the directors of large geological surveys; (5) of those members of the congress whom it should invite to sit with it."

This view of the comité fondateur has been adhered to in every one of the four sessions of the congress, held respectively in Paris, Bologna, Berlin, and London.

In all these sessions the congress has called every member of the American committee who happened to be present to a seat in the council (with a single accidental exception), and has thus defined what it means by the "comité fondateur."

To sum up the case: (1) The American Association appointed a committee to investigate a question. Instead of investigating and reporting, it proceeded to create a congress.

(2) The congress created in turn this committee an integral part of its own governing body.

(3) With the organization of the first congress the need of a committee to inquire into the propriety of it ceased, but the American Association practically changed this original "propriety" committee into its representative at the various sessions of the congress, and has been constantly receiving reports from it, and adding to its number for eleven years.

(4) The congress, by its action in receiving all the American Association's additions into its council, has proclaimed that it is not the original members of the comité fondateur at Buffalo, but the membership of the committee representing the American Association before itself that it considers the comité fondateur.

(5) This American committee has further taken the place of the national committees of other countries, and as such has collected information and published reports illustrating American opinion on geological subjects.

It thus appears that the American committee has filled four rôles, the first, or that of inquiry, ceasing as the other three began; and for the proper fulfilment of the three simultaneous functions, which it has been exercising ever since 1878, it is amenable to three independent bodies. That one which may claim priority of age (since the duty of investigation was rendered nugatory by the absolute establishment of the congress) is the congress itself, to which the committee's relations are those of a parent recognized as a member of its household; next is the American Association, for which the committee has appeared in the debates of the congress as a representative; and last are the geologists of North America, whether members of the A. A. A. S. or not, of whom the committee has the right (in view of its past labors) to consider itself the mouth-piece.

In the light of the foregoing facts, it remains to be decided what action this committee proposes for itself in the future.

Shall it, as the national North American committee, set about the

work of preparing a report for the coming meeting of the International Congress in this country? In this case it is to be desired that the work should be commenced without delay, either through the sub-committees already appointed or through others.

Or shall it accept its discharge at the last meeting of the A. A. A. S. as a committee "on," and lapse into the passive glory of the comité fondateur "of" the International Geological Congress, like a soul on which this mortal conception has conferred immortality? Whichever it may decide to do, there is at least one duty of which it cannot divest itself. By virtue of its character as representative of the geologists of North America it has become the responsible subscriber for the edition of the geological maps of Europe assigned to America as to other "great countries." By diligent inquiry it has procured a list of institutions and individuals, together making up the ten thousand francs for the one hundred copies which the map committee in Berlin has agreed to furnish to it. The committee is responsible to the North American subscribers for the delivery of these maps and the map committee in Berlin is pledged to furnish them to the committee. Before ceasing its mortal and commencing its spirit career, therefore, the most elementary considerations of propriety require that it should provide for the fulfilment of this obligation. How this should be done cannot be determined without a meeting of the ex-committee *on*, who might be called together as the existing committee *of* the International Geological Congress.—PERSIFOR FRAZER.

SCIENTIFIC NEWS.

The third session of the Marine Biological Laboratory at Woods Holl was the most successful in the history of the institution. During the winter and spring a large addition was made to the building, giving six additional studies for advanced workers, and affording rooms for library and for lectures. This necessitated other changes. The old library quarters were fitted up for a chemical room, while a dark-room for photographic purposes was arranged. The crying need in past years was a steam launch, and this want has been met by the purchase of a thirty-nine-foot Burgess launch, capable of doing all the work required of it.

The attendance both of students and investigators was larger than ever before. In the department of instruction twenty-six students were enrolled, some coming from the distant States of South Dakota, Nebraska, Kansas, and South Carolina. There were seven present who were beginning investigation under instruction, while fourteen

more were conducting original investigations. Some of the results of the work done will be published at an early date.

During the summer the laboratory purchased four additional lots of land just north of the premises of the U. S. Fish Commission. On one lot there is a dwelling-house, which will be used in future for a mess-house for students and instructors. It is proposed to move the present laboratory to another of these new lots; while on a third, when funds warrant, it is proposed to erect a permanent station at which work can be carried on throughout the year. As a result of these expansions, the laboratory concludes the year with a deficit, but one which is not so large as to occasion serious worry. It is desired, however, to obtain as much aid as possible, and the trustees feel that all the funds should not come from Boston. So far but about one-fifth of all the students have come from Massachusetts; while, on the other hand, Boston has contributed over ninety per cent. of all the funds.

The Western Society of Naturalists will hold its annual meeting this year in the buildings of Purdue University, at Lafayette, Indiana, November 12th and 13th. Dr. C. E. Bessey, the retiring president, will deliver the annual address. A feature of the meeting will be the discussion of natural science as a requirement for admission to college. The secretary of the society is Dr. J. S. Kingsley, of Lincoln, Nebraska.

Howard Evarts Weed, M.Sc., recently a graduate student of the Michigan Agricultural College, has been appointed entomologist and horticulturist of the Mississippi Experiment Station.

Professor S. A. Forbes spent the summer in the Yellowstone Park investigating fish food conditions for the U. S. Fish Commission.

Mr. A. B. Cordley, of the Michigan Agricultural College, has been appointed entomologist of the Vermont Experiment Station.

At the recent meeting of the Society for the Promotion of Agricultural Science, Dr. C. E. Bessey was re-elected president, and Prof. W. R. Lazenby secretary, while Prof. H. W. Wiley was elected to the executive committee. The following gentlemen were elected members of the Society: Prof. L. H. Bailey, of Cornell University; Professors Chas. S. Plumb and W. E. Stone, of Purdue University, and Prof. B. E. Fernow, of the U. S. Forestry Division.

The cotton worm has been recently receiving attention at the hands of Messrs. G. C. Davis and F. W. Malley, the former for the Arkansas Experiment Station, and the latter for the U. S. Department of Agriculture.

L. H. Dewey, recently of the Michigan Experiment Station, has been appointed an assistant in the U. S. Division of Botany.